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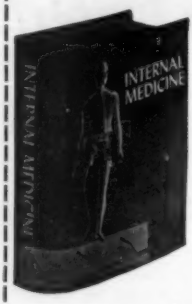

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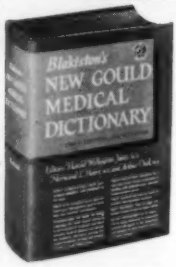

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Books and the Future

IN THESE critical times, American publishers of scientific and technical books carry a heavy responsibility. For one thing, English has become more and more the international language of science. For another, in order to meet the need for up-to-date books on specific subjects, it has devolved upon publishers to seek out authors and encourage them to write.

The academic author is a busy man, who often carries the multiple burden of teaching, research, and administration, and whose writing is therefore relegated to his private life. The research worker presents another problem. Universities, government, and industry are convinced of the value of research, but they are not always fully aware of the necessity of making the results of research readily available in book form. Yet a continuous production of good new text and reference books is vital for the training of future generations of scientists, engineers, and research workers.

To provide this flow of books, the publisher must make long-term plans—plans flexible enough to adjust to unforeseen events and developments. Past experience must be the basis for these plans. From the start of the century, scientific publishing has, in general, kept pace with the advance of science and technology, although economic conditions have inevitably caused fluctuations. As this publishing house looks back over the last two decades, certain conclusions emerge from the data on annual output of new books.

After the depression of the early 30s the number of new titles published annually remained about the same for seven years, 1935–41. We may refer to this as the "normal" period. In 1942–43 the output jumped 50 per cent, reflecting the urgency felt by authors and publishers to meet wartime requirements. For three years beginning with 1944, however, production declined to 25 per cent below "normal." Scientists and engineers were devoting their efforts to research, production, and training; national security, also, placed limits on publication.

Although by 1947 the trend had reversed, for three years new publications increased only 25 per cent above "normal." Record enrollments handicapped academic authors; reconversion and expansion were the first concern of others. In 1950, the increase had reached 100 per cent above "normal," and this level will be maintained in 1951.

The publisher's present problem is to prevent a recurrence of the disastrous lean period of 1944–49, when, in the face of acknowledged need, there was a dearth of the new books on which the growth of science and technology depends.

The lack of a program for universal military training and service has seriously interfered with the proper functioning of colleges and universities since the war began in Korea. Now the remedy is at hand, and the pessimism that only a few months ago guided the thinking of educators and textbook publishers should give way to constructive planning. If world conditions do not force us to mobilize completely, by the end of 1952 a substantial percentage of the 1950 inductees will resume their education, followed in due course by later inductees. Most important of all positive factors, however, is the increase in our birth rate which, beginning in 1940, by the end of that decade reached a rate one third higher than the 30s, and appears to be continuing at that desirable new level. Specifically, there were just over 2 million births in 1932 (present 18-year-olds), more than 2½ million in 1941, and in excess of 3½ million in 1948.

The future, as always, is uncertain. Publishers and their authors should continue to plan for it with courage and optimism, for there is ample evidence that academic and professional demand for scientific and technical books will within a few years be greater than ever before.

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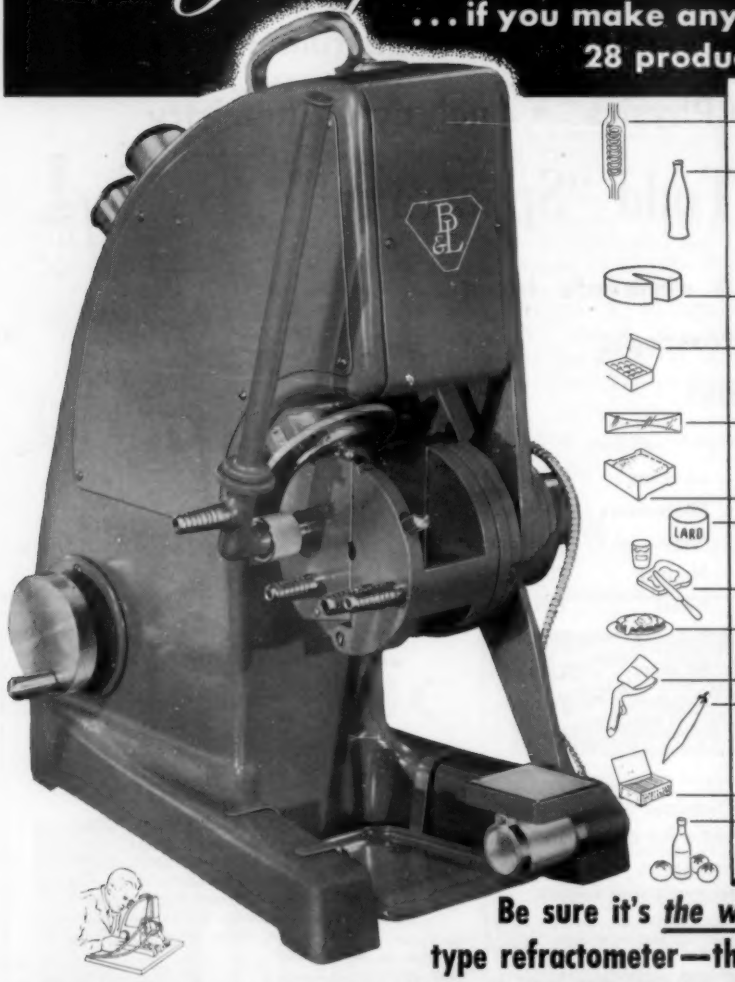

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Current Science Reading

Kirtley F. Mather

Department of Geology and Geography, Harvard University, Cambridge, Massachusetts

AS USUAL AT THIS TIME OF THE YEAR, the array of recently published scientific literature is overwhelming in quantity, but sufficiently rich in quality and adequately diversified in content to satisfy the needs of the most particular of readers. No scientist should be so confined within his own special field that he cannot keep himself informed about the progress of science in general and the ferment of ideas in the community of which he is a part. To see the forest, as well as to dissect or carve the tree immediately in front of one, is an essential part of the indefinable spirit that distinguishes the scientific man from other varieties of our species. Here, then, are a few notes that may be helpful in selecting something to read during off-duty hours.

Let's begin with a bit of relatively light reading. Bertrand Russell delivered three lectures at Columbia University last November, under the sponsorship of the Franklin J. Machette Foundation, an organization established "to interest the public in philosophy." The lectures certainly merit the wider audience resulting from their publication as a book.[1] All of Lord Russell's fine sense of humor, incisiveness of diction, and keenness of insight are preserved, so that as one reads the printed page it is easy to see him in imagination as he stood before his audience.

Speaking first of "Science and Tradition" and then of the "Effects of Scientific Technique," Lord Russell contrasts the ancient and the modern views of the nature of the world and of man, and surveys the results of technological developments in recent years. The third lecture deals with "Science and Values," but Lord Russell was thinking about that well-known problem in essentially practical terms rather than from the point of view of an aloof philosopher. Some of you who are grappling with that problem on a deep level will think that his treatment is somewhat superficial. He was, however, addressing a "general audience" and had a very practical purpose in mind.

In summary, his thesis is that far greater well-being than has yet been known may be obtained in the immediate future if men can accomplish the abolition of war, the even distribution of power, and the limitation of population. To achieve those obviously desirable objectives, he recommends not an increase in knowledge alone but also a strengthening of the spirit of love and compassion. He even calls it "Christian love"!

While convalescing from a major operation last summer and fall, President Conant improved the opportunity to produce some very powerful ammunition for his well-known campaign to increase general understanding of the "tactics and strategy of science." He calls his latest book[2] "A citizen's guide to the methods of experimental science." The orientation is quite different from that of his earlier book, *On Understanding Science*, for this one is directed toward all who are involved in the practical problems of the mid-century years, rather than primarily toward those concerned with the education of youth for life in a free society. Appropriately enough, however, considerable portions of the earlier book are woven into the fabric of the new one.

There is space here for only a few of the many highlights of this thoughtful and exceedingly interesting volume. Writers of popular science are advised to indicate more definitely "the distinction between speculative ideas, broad working hypotheses, and well-tested conceptual schemes (though there is, of course, always a hazy boundary between the three types of ideas)." The history of each of the natural sciences includes many examples of the recurring phenomenon, "that the time must be ripe for new ideas to become fruitful or new experience to be appreciated." Speculations leading to ideas that are fruitful of experiments in the laboratory or new observations in the field are useful; "otherwise the free play of imagination can do little more than provide entertainment." Quite commonly it is possible to draw clearly the "contrast between vague speculative ideas and fruitful conceptual schemes."

The necessity for careful distinction between speculative ideas and firmly supported concepts imposes a responsibility upon all authors of scientific literature, but it also should keep all readers alert. Unless we are vigilant we are likely to be led astray by such a book[3] as the one that happens to come next to hand. Fred Hoyle is a brilliant young Cambridge University astronomer who displays a commendable flair for presenting intricate data and mind-stretching ideas in lucid, attractive style. *The Nature of the Universe* is sure to draft a host of readers and be the spark plug for many an earnest conversation. It is in fact a stimulating and informative book, but it should be read with great caution.

Mr. Hoyle presents quite accurately an abundance of information about the recent advances in knowledge concerning the composition of interstellar gas and "dust" that constitute a large fraction of the total mass in the Milky Way galaxy, the presence of "background material" in the vast spaces within the

[1] Bertrand Russell. *The Impact of Science on Society*. New York: Columbia Univ. Press (1951).

[2] James B. Conant. *Science and Common Sense*. New Haven, Conn.: Yale Univ. Press (1951).

[3] Fred Hoyle. *The Nature of the Universe*. New York: Harper (1950).

universe between the galaxies, and the numerous other significant aspects of the universe that are now undergoing observation and study by astronomers throughout the world. His report concerning recent application of principles of electrodynamics to astrophysical problems is wholly trustworthy. His majestic picture of the universe according to "the New Cosmology" is vivid and impressive. His presentation of the concept of "continuous creation," contrasted with the "big bang idea," is scholarly and convincing. But he overreaches when he comes to hypotheses of stellar and planetary evolution and to speculations concerning matters that are at present beyond the pale of "fruitful" contemplation.

For example, he writes dogmatically that "there was once another star moving around the Sun that disintegrated with extreme violence." There is no hint that this is a speculative idea, as yet hardly qualified even to be rated as a working hypothesis because no means are at hand for applying rigid tests of its validity. Or, again, he states that he has "described the way in which planetary systems like our own come into being." He should have said "*a* way in which planetary systems like our own *may perhaps* have come into being." Similarly he "estimates" that there are at least 100,000 planets within the Milky Way suitable as the abode of life, but only the alert reader will be aware that concealed behind the apparently conservative mathematics there is a precarious inverted pyramid of speculation piled on speculation after speculation, interlarded with slippery assumptions.

In contrast, W. C. Allee discusses in his latest book[4] a wholly different, but equally "controversial" subject, with due deference to the advice that I quoted from President Conant's book. Dr. Allee has retired from the University of Chicago as professor emeritus and is now the head professor of biology at the University of Florida. The book in hand is a revised and amplified edition of *The Social Life of Animals*, published in 1938, and like its predecessor it stresses the human implications of the basic principles of biological relationships observed in many groups of animals. It comes at a crucial moment in human history and deserves a sufficiently wide reading to make its cogent reasoning influential in the political debates, great and small, that now demand the attention of every citizen.

Among other things, the book surveys the types of modern evidence concerning the existence of cooperation as an important factor in evolution.

> In so far as any international organization, formal or informal, is based primarily on a hierarchy of power, as are the peck orders of the chicken pens, the peace that follows its apparent acceptance will be relatively short and troubled. . . . The continuing success of the United States as an integrated unit is closely related to the lack of emphasis upon possible peck orders among the states. . . . Widely dispersed knowledge concerning the important role of basic cooperative processes among living beings may lead to the acceptance of cooperation as a guiding principle both in social theory and as a basis for human behavior. Such a development when it occurs will alter the course of human history.

The importance of cooperation in an increasingly significant area of human behavior is implicit in the next book[5] on my list. Emphasizing the hopeful side of the story of atomic energy, Dr. Sacks, of the Brookhaven National Laboratory, devotes a large part of it to the uses of radioisotopes in medical research and therapy. Many significant advances have already been made, and much interesting material, heretofore available only to specialists, is presented for the general reader. Most of such readers will be amazed by the wide variety of ways in which isotopes are now being used—in chemistry, biology, medicine, agriculture, and industry.

Another book that hews closely to the line of scientific accuracy and properly restrained speculation, in spite of its highly imaginative title, is *The Flight of Thunderbolts*.[6] Its author is a member of the Bernard Price Institute for Geophysical Research, University of the Witwatersrand, Johannesberg. Printed in Great Britain, it has been made readily available in this country through the New York office of the Oxford University Press. As all who know their Gilbert and Sullivan will immediately infer, it deals with lightning and atmospheric electricity. The subject provides a case history of general interest, in its progress from myth to knowledge, and it is presented here as an excellent illustration of the scientific method in action. It includes also a wide gamut of problems that are of great practical importance in radio communication as well as of significance in electrodynamics and meteorology. The interest of those who have a particular concern with lightning protection is obvious.

Mr. Schonland approaches the subject from the historical angle and begins with a survey of folklore before recounting the invention of the lightning rod by Benjamin Franklin. He then proceeds with descriptions of the various forms and effects of lightning. This prepares the way for a scholarly consideration of the luminous processes involved in the lightning flash and the electrical processes in the lightning discharge. From an unusually able and interesting discussion of protection against lightning, he goes on to the more theoretical aspects of the electrification of thunderclouds and the indirect and distant effects of thunderstorms. All in all, the book is an outstanding example of good scientific literature, presenting in clear and supple style a subject fraught with widespread interest and involving concepts that have only recently been developed by contemporary researchers.

Finally, there are two excellent books[7] for those of philosophical bent and an interest in the history of ideas: Dr. Reichenbach's book is intended for readers who have "common sense enough to wish to learn more

[4] W. C. Allee. *Cooperation Among Animals*. New York: Schuman (1951).

[5] J. Sacks. *The Atom at Work*. New York: Ronald (1951).

[6] B. F. J. Schonland. *The Flight of Thunderbolts*. New York: Oxford Univ. Press (1950).

[7] Hans Reichenbach. *The Rise of Scientific Philosophy*. Berkeley: Univ. of Calif. Press (1951); W. P. D. Wightman. *The Growth of Scientific Ideas*. New Haven, Conn.: Yale Univ. Press (1951).

than common sense can teach" them. Its thesis is the concept "that philosophy has proceeded from speculation to science." It first examines "the shortcomings of traditional philosophy" and then turns to an exposition of "modern scientific philosophy," collecting "the philosophic results that have been developed through the analysis of modern science and the use of symbolic logic."

The author is professor of philosophy in the University of California at Los Angeles, well known for his previous books and other writing. Here he sums up the results of his earlier studies in a comprehensive and very readable treatise, containing within its pages all the necessary scientific information to give a modern world view.

Dr. Wightman has recently become the first holder of a new lectureship in the history and philosophy of science at the University of Aberdeen. His book was published in Great Britain last year, and the American edition is being released the middle of May. In it, he follows the stream of scientific thought from Thales to the philosophers of the twentieth century, relating each step of discovery to past and future. Science is revealed as "a struggle no less charged with humanistic value than the struggle for political liberty or national expression." Although the intimate relations between scientific theories and technological demands receive appropriate attention, Dr. Wightman does not regard "the socioeconomic as the sole directive in the cultural advance."

Books, Civilization, and Science

Warren Guthrie
Department of Speech, Western Reserve University, Cleveland, Ohio

IT IS WITH A GREAT DEAL OF UNCERTAINTY AND HESITATION that one whose field is rhetoric and public speaking—that knack little better than cookery in Plato's eyes—even ventures near the habitat of men of science. To us science *is* a sacred cow; the scientist, in turn, commonly accepts our discipline as a part of college and university training, with some tolerance but with little enthusiasm.

Why, then, do I write of "Books, Civilization, and Science"? Because a few months ago it was my good fortune to moderate a discussion on this so sharply limited subject at the annual meeting of the American Association for the Advancement of Science in Cleveland. Participating in the discussion were Kirtley Mather of Harvard, Ralph Gerard of the University of Chicago, James Stokley of the General Electric Company, and David Dietz of the Scripps-Howard newspapers. Representing publishers of scientific literature were Hugh Kelly of McGraw-Hill, Charles Skelley of the Macmillan Company, Herbert S. Bailey, Jr., of the Princeton University Press, and, in the absence of Edward Crane of D. Van Nostrand Company, Dennis Flanagan of *Scientific American*. May I hasten to relieve them, individually and as a group, of all responsibility for any statement made in this report. The following lines are my effort, as moderator of the discussion, to summarize the content of that extremely interesting two hours. For such of value as it may contain, credit their contributions to the discussion itself; where it may seem in error or ill-considered, blame the inaccuracies of this reporter.

That there is great need for the writing and publication of scientific books directed to the general reader was apparent to everyone. With the achievements of science an ever-increasing force in our civilization, the need for wide dissemination of scientific learning and method hardly requires proof. Not only is there imperative need for the encouragement of scientific habits of mind; there is an almost equal necessity for acquainting the public with new discoveries and concepts resulting from current scientific research.

Further, the times seem to offer unusual opportunity for meeting this need. The reading public is interested in scientific matters. Its interest has made some scientific—and more pseudo-scientific—books best sellers. Scientists themselves are more aware of the need for interpretation of their field than in many decades. Forced into public life by the tremendous social impact of the discoveries they have made, they seek to help in the constructive, rather than destructive, use of their knowledge. And, finally, there is now an abundance of the kind of material in which the lay public will take interest. New and revolutionary ideas and concepts are literally streaming from our research laboratories. The novel is inherently interesting; the revolutionary demands attention.

With these factors immediately apparent in our discussion it might have seemed in danger of bogging down from lack of a problem, but such was far from the case. For the publishers frequently print, it was charged, and the public likes, the sales records show, the *wrong* kinds of scientific books. The best sellers dealing with matters scientific are those such as *Worlds in Collision* or *Dianetics*. More sound, more responsible, though less sensational works, even when written with an eye to the general public as audience, are seldom as widely read. It was with this problem that our group became largely concerned.

For the charge that they were at fault, the publishers had an immediate and effective answer. Most of the books against which the scientists were most

vocal were not listed by their publishers as "scientific." That the public regards them as such, say the publishers, is beyond their control. Furthermore, as Mr. Skelley pointed out, in at least one case in which a book that the panel regarded as unsound enjoyed a wide sale, the publisher voluntarily transferred his rights to another company at heavy financial loss. Other representatives of the publishing group made clear their interest in seeing that books presented on their scientific lists are acceptable to the scientific fraternity, as well as popular with the general public.

Nonetheless, the "wrong" kinds of scientific literature do get published. Feeling that there should be some protection to the public from the unsound, and a consequent greater interest in the best scientific writing, the panel offered several constructive suggestions.

First, to assist the publishers in their job of selecting those manuscripts that merit publication, it was suggested that some sort of board of review be created from the ranks of the scientists themselves. This board would be quick to eliminate the spectacular but nonscientific. To the criticism that such review might involve a kind of censorship that would deny the right of publication to any truly revolutionary work—sound or unsound—there was, however, no final answer. Consequently, the panel began to explore other means by which the same problem might be met. The answers seemed to lie in the development of a set of principles by which publishers might be guided, rather than in the support of a board of review.

Those principles followed, in general, a proposal presented by Dr. Mather. Underlying the plan was the realization that most members of the general public, and even some publishers, are unable to distinguish the "plausible but false from the astonishing but true." Always to be regretted, in a period when mass communication and general tension make the individual especially susceptible to propaganda, such false and sensational writing was felt to be more than a disservice to science and to civilization, and it may now be a positive danger. Step one in the selective process can come from a reawakening of those in editorial offices to one of the cardinal principles of scientific methodology in a free society.

In this sort of society the scientist is encouraged to be revolutionary, to conceive and proclaim new ideas. No truth is regarded as absolute, no answer ultimate. Only from new and frequently daring hypotheses can progress come. But this does not mean that every proponent of a new idea or theory deserves an immediate public hearing, backed by the reputation of a widely accepted publisher. That "testimonial" is hardly earned until the writer follows a procedure long tested in science, be he a venerable academician or a young unknown. Before the new theory is presented to the frequently gullible public, it should be submitted to a jury of the writer's peers—to those who by training and experience are most competent to examine and to criticize it. Such juries are legion—they are the professional societies of scientists, the technical journals of each of our fields of learning. Here scientific minds meet in direct association. Here is the cauldron of controversy where precious metal may be separated from dross. Here the new theory may survive its ordeal by fire.

No publisher, said Dr. Mather—and his colleagues seemed generally to agree—should yield to the temptation of selling a book full of radically new or obviously unorthodox ideas until he has learned of the previous presentation of those ideas to the scrutiny of the author's scientific peers in technical journals or at professional meetings. Wide acceptance by those judges was not felt necessary—scientists are sometimes as guilty of reactionary conservatism as the rest of us. Louis Agassiz' theory of a "great ice age" seemed just as preposterous to many people when first announced, as Velikovsky's theory of "worlds in collision" seems today. Agassiz' theory, in fact, was ridiculed as the "glacial nightmare." But Agassiz adhered to the routine described above; Velikovsky bypassed astronomers and geologists and went straight to the general public. Such failure to submit the material and gain at least a modicum of support should be a signal of clear and present danger to any publisher.

The second answer to the problem of the publisher was thought to lie in the labeling of his product. Since he must, after all, produce popular works if he is to survive, it was felt that even the most arrant nonsense might occasionally justify publication—even as does a *Forever Amber* or an *Anthony Adverse*. The labeling, however, should be careful, so that the pseudo-scientific is tagged as the fiction it actually is.

To the other half of the problem posed—the fact that responsible works, even when written for the general public, seldom secure a wide audience—the answers were far less clear. It's the familiar problem common to all of us in education—thoroughly adjusted to the captive audiences we so often face, we are frequently less than satisfactorily effective when confronted by the free world outside.

Our excuses for our ineffectiveness are, of course, many, and their actual truth makes them all the more persuasive. Competent and successful research scientists are generally too busy to undertake the job of clear and simple writing. Even when they assume that responsibility, they are frequently incompetent in the sense that they do not possess the flair essential to the dramatization of their ideas. After all, as the members of the panel so capably pointed out, it is inherently an extremely difficult and time-consuming task to translate the language of modern science into the vocabulary of the general reader. Time spent in this task is time *not* spent on productive research. Thus many of our most able scientists simply refuse to attempt to write for popular consumption.

Yet there can be no doubt of the necessity of making science clear to the layman. The tragic results of his ignorance and misunderstanding are constantly before us. And it must also be recognized that it is a far easier task to put the achievements of science into terms that can be understood by the public than to

bring that untutored public up to the standard of education that will make them able to comprehend the specialized language of the scientist. Certainly there can be no virtue in dullness or lack of clarity.

Some progress is being made. The occasional scientist who does succeed in popularizing his science is no longer a pariah. To an extent undreamed of a generation ago, he may even receive critical acclaim. Step one in improving the public appreciation of scientific achievement must be a continuing recognition of the value of this kind of writing. Its importance in the whole advancement of civilization grows greater by the day.

Further, there are now available competent science writers—men whose primary skill is communication, but whose scientific training provides them with the basic knowledge required for accurate reporting of scientific achievement. To these men should be given the wholehearted support and encouragement that can come only from those actually engaged in the research reported by the writers. Not only do they merit help in general—they should be given the opportunity to collaborate with top-flight research scientists in carrying the results of this research into the minds of the mass reading audience. Science writers have already been able to do this job in many instances. With wholehearted support, they can do much more.

There are, of course, many pitfalls in the path of successful collaboration. It is, however, one answer to the problem of making reports more palatable, and for the scientist who begrudges any time taken from his laboratory it may be the only practical one. Even the "ghost writer" of Washington and Hollywood fame may one day find his niche in science, also.

Two additional solutions were proposed. Each would involve the acceptance by the scientist of his responsibility to write clearly and interestingly, and his willingness to work at his skill as at any other necessary technique. The results should justify the effort. Magazines of relatively large circulation can provide the testing ground for the scientist willing to learn the necessary skill in communicating his ideas. By submitting articles with regularity—seeking an ever more cogent style—the research scientist can begin to compete with his less able but more dramatic colleague for popular interest. Such magazines provide one means of disseminating information to an increasingly large audience as well.

The last answer proposed by the panel was even more fundamental. Perhaps, if the scientist is to assume his full responsibility for the communication of his knowledge to a troubled world, he must be more of that world himself. His interests can no more be limited by the four laboratory walls than can the results of his tests and research. Although his forte may be science, his study of, and interest in, the humanities must never lag far behind.

Here our British colleagues offer an encouraging lead. Broader in their educational training in almost every instance, generally more catholic in their interests and tastes, almost always more skilled in their use of language, they succeed in arousing interest where we often fail. Where our own writers have combined scientific achievement with broad, humanistic interests, we, too, have achieved science and sanity at the same time.

Preoccupied as I am with the field of communication, it was a heartening experience to see this concern on the part of the scientist. Ours *is* one world in the sense that the achievement and success of each of us has its inevitable effect on the lives and fortunes of others. Only when we seek mutual understanding and progress on the highest generally popular level available can that effect be the forward movement of all things—books, civilization, and science included.

Science and Literature

J. R. Pierce
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MOST PEOPLE LIKE TO BE WRITTEN ABOUT, whether they can justify the feeling or not. Scientists are no exception. Of course, we like to see our technical papers quoted, for that helps give our own particular contribution the emphasis it deserves. We don't mind seeing our names in the newspapers, either, for no particular reason unless we believe that well known means well paid.

Next to appearing in print ourselves, we get a certain vicarious satisfaction from being associated with publicized matters. It is only human to feel that "it's my laboratory," or "my committee," or "my field of work" that is receiving so much attention. And I think it is perfectly all right to feel a little pleased, too, that people are taking such an interest in science-fiction. This seems to show that they have an interest in science and, indirectly, even in you and me. We might as well like it, for we cannot change the fact that a version of science and scientists is being presented to a growing group of readers in this way.

We may please ourselves by believing that science has a good deal to offer to the field of literature. Aren't scientists and science worth writing about? And don't people ever get tired of stale adventures, stale surprises, and stale ways of killing and of hiding

the crime? Think of the ingenious gadgets one can almost make. Or think of the wonders we could work by violating just one or two laws of science. If that isn't enough, think of the effect that new devices or new principles, possible or impossible, could have on whole civilizations, and even more strikingly, on individual people like you and me.

If it is escape that one wants, why not escape right off the world, to the planets or to the stars? It seems startlingly arbitrary that things here have turned out as they have. What other kinds of creatures would there have been under conditions just a little different? And what strange sorts of civilizations might they have worked out?

These matters have been exploited, and sometimes very effectively. In *A Slip Under the Microscope,* H. G. Wells takes us into a real school and laboratory. In *The Plattner Story* he takes his protagonist a good deal farther, into the fourth dimension, and Plattner comes back duly turned mirrorwise. In *The Time Machine* Wells takes us into a non-Utopian future; in *The First Men in the Moon,* all the way to that satellite; and in *The War of the Worlds* he brings the men of Mars here. Indeed, his scope was amazing before his message became so important to him.

But in quantity if not in quality today is the day of science-fiction, though Wells remains as an admirable and exasperating standard of comparison. Many ingenious authors have written much that is amusing and some things that are instructive. The atom bomb had been thoroughly explored before it fell. Time travel, which Wells himself thought up as a parascientific project, has had its paradoxes raveled (certainly not unraveled!) in such stories as Robert Heinlein's *By his Bootstraps.* Heinlein also had an entertaining whirl at the fourth dimension in *He Built a Crooked House.* Later he wrote the story on which *Destination Moon* was based and he was connected with the production of that admirable, almost documentary, film.

Then there was Stanley G. Weinbaum, who wrote that amusing tale of exploration, *A Martian Odyssey,* with its silicon-based life and its other creatures, thinking and unthinking, who seem at once so plausible and so beyond our understanding.

In the field of technology, science-fiction writers have explored the space suit (how does one make the arms flex without changing the volume, and does the man inside freeze or swelter?), rocketry and space navigation, including the problem of meteors, interplanetary communication, and, in other fields than space travel, a host of matters including, of course, large-scale computing machines and robots (cybernetics to you?).

In what some have taken for its maturity, science-fiction has tended more and more to go beyond isolated ideas and gadgets and to speculate on the effect of science on human beings and on social organization. Don A. Stewart, who is John W. Campbell, Jr., the editor of *Astounding Science Fiction,* wrote some pioneering stories about the very remote future. Isaac Asimov, a chemist, has constructed some amusing societies, and Heinlein wrote a whole history of the future, period by period.

All in all, science-fiction has brought a great deal to writing besides a recognition of the importance and popularity of science. In some measure, it has brought science itself. Further, it has brought a new dimension of escape, and an unfettered mind to explore it. Cut off (would you say?) from reality, or at any rate from the limitations of time and place, prejudices, taboos, social forms, and revealed religion lose some of their sanctity, and the large body of readers is not shocked by a Negro chief executive, a socialist economy, or an entirely unorthodox church.

All this seems to the good, and, in my enthusiasm to convey something of it, I went through three of the latest anthologies of science-fiction, *The Big Book of Science Fiction* (Crown Publishers), *The Best Science-Fiction Stories—1950* (Frederick Fell), and *Journey to Infinity* (Gnome Press), thinking to recommend them to readers of SCIENCE. I'm not sure that I want to.

These stories are mostly recent, and the older ones presumably represent the taste of today. They are well written. Indeed, science-fiction writing (disregarding content) has never been more professional than it is here. Some of the stories were slick enough to appear in the *Saturday Evening Post.* Ray Bradbury's writing can move one with practically nothing.

What bothers me is that few of the stories have any scientific ideas in them, and, in fact, not many have ideas other than those of the most obvious sort: the atom bomb is dangerous, empires must fall and dark ages come, dictators will be destroyed. Of course, there are exceptions, but even some of the best stories by the best writers suffer from maladies of the times.

In an amateur way, I think I know something of what is wrong. In the beginning, science-fiction was written by odd people here and there. If they were odd geniuses like H. G. Wells, the stories were acceptable by any standards. If they were just odd and thoughtful people, the stories would suit only an odd and thoughtful audience. Such were the contributions of the early days of *Amazing Stories,* which Hugo Gernsback founded in 1926.

Later, science-fiction caught on with the juveniles, and high-speed pulp writers took over the field. From this state, sorrier even than that of the present, John Campbell rescued science-fiction when he became editor of *Astounding Science Fiction* in 1937. Campbell got stories from a variety of amateur or part-time writers, many of them scientists or engineers, and from writers with a natural technical bent (Will Jenkens, for example). A great many ingenious and acceptably written stories have been published in *Science Fiction.*

A view that Campbell holds dear is that the important matter is not the gadget but its effects on human beings and, even more, on human society, and that these effects must be revealed through a story with a snappy plot. This doctrine can have evil consequences

if applied rashly, and perhaps it has served as an excuse for a progressive deterioration of the hard scientific and technological core in much of science-fiction. Many present stories are built, not around science and technology, but around a bag of standard magic tricks. Time travel—a convenient hyperspace to outwit relativity and to enable one to travel faster than light—robots and thinking machines that have arbitrary limitations or no limitations whatever, are standard but overworked ingredients. Like an old-style whodunit fan who feels that ingenuity and clues are as necessary as sex and blows, I can't go along with this. I like to escape, but I'd rather escape into something clever and amusing.

Science-fiction these days runs to more parsecs and longer eons. As an ultimate absurdity, one writer tells about a dynamic intergalactic culture which is forced to abandon its expanding way of life when it finds that the universe is finite.

In quick-paced writing on such a scale, the distinctive features of persons and cultures are lost. There is no time to describe strange societies, strange beings, or strange individuals, and all become standardized, a part of the bag of magic tricks. Personally, I'd rather have pure fantasy and go with L. Sprague de Camp and Fletcher Pratt into worlds of magic in *The Incomplete Enchanter* (Faery Queen) and *The Castle of Iron* (Orlando Furioso), because there's something to see and something to think about. The inflating universe of science-fiction is far less astonishing than what anthropologists find in the South Pacific, or among our own Indians, for that matter.

No doubt a good deal of this inflation is a result of increased popularity and increased demand, for not only are standard publishers jumping into this newly profitable field (yes, and the *New York Times Book Review*, the *Saturday Review of Literature*, SCIENCE, and other respectable publications have reviewed science-fiction), but two new magazines, good of their kind (*Galaxy* and *Fantasy and Science Fiction*), have been founded. Such markets are attractive to professional writers. A professional writer new to the field naturally tends to pick up the magic words without much concern for the sense. Good writing does a great deal to make up for a lack of ideas.

We may be pleased that science is more and more invoked in popular writing, but perhaps it is invoked with diminishing reason. What will the outcome be? Aside from H. G. Wells, I have written largely of science-fiction as represented in such magazines as *Astounding Science Fiction*, *Galaxy*, and *Fantasy and Science Fiction*, and by authors who first published in such magazines. If we look for something better, perhaps we should look elsewhere. Certainly, the stories reprinted from the *Saturday Evening Post* have not been encouraging in content. In the few in the *New Yorker* there is less than meets the eye. One really choice tale, "The No-Sided Professor," appeared in *Esquire*. In general, however, scientists have no reason to be happy over the short stories published in unspecialized magazines.

Of course, there have been novels with a scientific element or background, a good many if one goes back far enough. In reasonably contemporary times, Karel Capek (of *R.U.R.*) wrote three: *The Absolute at Large*, *Krakatit*, and *War with the Newts*. These were ingenious and well written, if scientifically a little weak. Ward Moore's *Greener than You Think* has a certain sweep and plausibility. G. R. Stewart's careful novels are closely related to science and technology. To me, Max Ehrlich's popular *The Big Eye* was disappointing, for all its Palomar background, and Vincent McHugh's *I Am Thinking of my Darling* rather dull and full of double-talk. One doesn't know what to make of Philip Wylie's self-assumed and bewildering advocacy of science. One could scarcely better Huxley's cleverness and good writing in *Brave New World* and *Ape and Essence*, nor Orwell's in *1984*; in these books, however, there is so much of an ax to grind that the science is incidental and rather distorted.

Indeed, in looking back, *Arrowsmith* seems an amazing achievement, for it presents through convincing people something of research and research laboratories. In this it stands almost alone, though there have been many good stories of medical practice. In writing *Arrowsmith* a fine and conscientious writer sought competent advice, a rare and commendable occurrence.

Perhaps the fundamental difficulty of finding science in a novel is the difficulty of finding anything of the world's daily work in a novel. About writers, artists, actors, publishers, advertising men, bullfighters, and politicians we can learn something by reading novels, but most occupations are carried on outside the pages of fiction. Maybe we don't like to read about anything that seems like work. Perhaps, however, it is merely that writers don't know much about how the world's work is done. Perhaps science and the complicated social and technological structure in which it is enmeshed are foreign to writers.

If other people don't write well about science and scientists, perhaps scientists will. Almost anyone has, at some idle moment or another, thought of an amusing aspect of science, either as it is, or as one might change it. What, for instance, of a suspension of inertia? A man jumping from a height is instantly and joltlessly at the bottom. One can walk but not leap. A thrown ball disappears from the hand and appears on the ground below. Of course there is no air pressure; the world rapidly collapses before one's mind, but not too swiftly for amusement. Biology must offer wonderful possibilities of truly strange creatures and strange ways of life. Surely not all of them have been exploited. And could not anthropology help in creating cultures more surprising than those repetitiously dull ones we find in typical stories?

We can easily picture the hobby-loving and enthusiastic scientist first reading a few anthologies to orient himself and to disclose too-well-trodden ground (Frankenstein's monster, the last man and woman on earth, worlds in collision, and the like) and then

plunging ahead to reform the field. There is a difficulty, however. Paint is cheap, and to construct a masterpiece one has merely to arrange paint properly on a flat surface. Stories are made partly of ideas, partly of characters, partly of an interesting sequence of events (plot), and wholly of the right words in the right order. It is pleasant to talk or to write about clever, well-thought-out and well-written stories which scientists might write around sound or diverting ideas, but it is much more difficult to write such stories than to talk or to write about them. How many will spend real effort in this dubious direction?

There is another possible remedy for the state of science in fiction. The lack of science in science-fiction merely reflects the lack of science in the public mind. One gets the impression elsewhere, as well, that the general knowledge of science—and in fairly respectable circles, too—is a mystical wash of relativity and uncertainty over a lack of pre-Newtonian physics. It is hard to explain the success of Velikovsky's *Worlds in Collision* in any other manner. Perhaps the easiest way to get good writers to write sensibly about science, and to get readers to ask something sensible of writers is to teach people about science.

Perhaps scientists should write popular articles rather than science-fiction. But here, too, the way is difficult. It is no good for men to be told about the new if they do not understand the old. And who will read an article about Newton's laws of motion, when an article about unified field theory seems fresher and more glamorous? Some humanists recommend old books for teaching old matter. But there is something ephemeral about the best of science writing, fact or fiction, for science continually sheds new light on old truths and continually binds old truths together. I think that most scientists would shudder at the idea of learning science from old books, beautifully petrified though they may be. Science is live and growing; the solid trunk, as well as the fresh shoots, is a part of today.

In the present, we know merely that people are increasingly interested in science. Science-fiction, science in stories and novels, show this, but they also show people's ignorance. The interest is flattering and good. Although there are many happy instances to the contrary, the ignorance is sometimes appalling. We wish people were better informed, but who will make them so?

The Cosmic Cinema[1]

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WILLIAM K. GREGORY is generally known as a paleontologist. A dictionary defines paleontology as "the science dealing with . . . the fossil remains of animals and plants." Nothing is more dead than a fossil. It is thrice dead. An animal that lived perhaps a hundred million years ago ceased to exist as a going concern. Its carcass suffered complete dissolution. The materials handled by a paleontologist are the more or less distorted mineral replicas of fragments of the carcass. But any fossils that have the good fortune to come into Dr. Gregory's possession do not long stay dead. At his hands they experience the miracle of the resurrection of the body. He assembles the skeletal fragments and restores the complete skeleton. Viewing the skeleton as a three-dimensional diagram of the mechanical stresses sustained by its several parts, he restores the animal's motor mechanism, the musculature, in its proper relation to the skeletal structures. Peculiarities of the teeth and jaws and of the locomotor appendages reveal the nature of the animal's food, the manner of getting it, and the animal's general mode of living. The relative size and the form of the cranial cavity tell something about the nervous mechanism. All available data having been evaluated, the animal, even if not alive "in the flesh," confronts us with a scientific reality not possessed by any mere ghost.

Gregory's *Evolution Emerging* is as far as possible from being a dull description of fossils. It is a story of Life in process of creation. It presents to the reader a marvelous pageant of ever-changing, living creatures ranging upward from the earliest, smallest, and simplest and culminating (in orthodox anthropocentric fashion!) in the human mammal. The pageant is presented not in words only, but by use of a lavish profusion of remarkably fine illustrations.

In *Who's Who in America* William K. Gregory is described as "paleontologist, morphologist." But in course of his story of "emerging evolution" he discusses the essential unity of the astronomic cosmos, the structure of the atom, the nature of time, and other subjects that are indefinitely remote from fossils and biological morphology. The behavior of animals leads him into psychology. The first paragraph of his Introduction, beginning with a reference to the philosopher Hobbes and his concept of a "leviathan state," concludes with these words: "The present work . . . deals with a complex pattern made up of innumerable pieces, the whole, nevertheless, being greater than the sum of its parts." The description in *Who's Who* is obviously a glaring understatement of

[1] *Evolution Emerging*. 2 vols. William K. Gregory. New York: Macmillan, 1951. 1,748 pp. Illus. $20.00. (Reviewed in galley.)

the breadth of interests and the range of knowledge possessed by the author of *Evolution Emerging*.

The reader of the book will be immediately impressed by the imposing magnitude of the work—two volumes, the first containing 704 large two-column pages of solid print, with no illustrations, the second containing 1,013 pages occupied exclusively by illustrations and their descriptive legends which, with few exceptions, are very brief. A bibliography fills 144 pages of Volume I. Based on a count of the references on five pages, the total number of citations (books or papers) must be approximately 5,000.

Volume I is arranged in six parts, the first of which consists of an Introduction and three chapters. Chapter I deals with protozoans, sponges, coelenterates, and worms; Chapter II, with mollusks; Chapter III, with arthropods. In the Introduction, entitled "The Cosmic Cinema," evolution is defined as "the natural history of the universe and its parts." Thus defined, evolution is announced as "The Master Key" to such understanding of the universe as may be possible for us. The author, discreetly avoiding probing too deeply into the dark past of the cosmos, begins with the origin of the solar system and the structure of the atom ("building-blocks of matter"). Passing then to a statement of his concept of "Polyisomeres and Anisomeres: the Role of Repetition and Emphasis," the Introduction concludes with the author's "Argument," which is set forth in 19 stanzas of what may be described as informal unrhymed verse. The stanzas range in length from four to eleven lines. An especially significant stanza, XII, may be quoted:

> Of earlier forms the habitus, or mask,
> That fits them for a special way of life,
> To all their seed becomes prerequisite,
> The basic portion of their heritage—
> "Preadaption" but not predestination.

This "Argument" is reminiscent of Erasmus Darwin's "Temple of Nature," in which his idea of evolution was expressed in rhymed verse.

Chapters I–III present an excellent survey of the several groups of invertebrates, with special reference to the features that are most significant as to evolutionary relationships.

Part II includes Chapters IV–IX, beginning with the "Coelomate Food-Sifters" (IV, brachiopods, polyzoans, and echinoderms), then passing on to the prochordates (V), ostracoderms (VI), placoderms (VII), sharks (VIII), and bony fishes (IX). In Chapter V the several theories of the origin of vertebrates are very ably discussed. Patten's arachnid theory receives especially lengthy and serious consideration but, for valid reasons, is rejected.

Part III (Chaps. X–XV) begins with "The Air-Breathers—Struggle for Life" (crossopterygians, dipnoans, early amphibians) and continues with the later amphibians, the reptiles, and the birds.

The seven chapters of Part IV cover the several orders of mammals, exclusive of primates. In Part V, Chapter XXIII considers the "Origin, Rise and Deployment of the Primates," and Chapter XXIV is headed "Man's Debt to the Past." This chapter is essentially a review of all the preceding chapters, but with special emphasis on those structural features that may be traced in a continuous and progressive series from the earliest living things to the present. In Part VI (Chap. XXV), entitled "Retrospect and Prospect," the author summarizes his ideas as to the mechanism of evolutionary emergence and clinches his introductory "Argument."

The gist of Part VI may be best presented by a series of quotations. Beginning with a slightly apologetic statement that he himself is "a sort of educational hybrid between Science and Philosophy," the author notes that "the concept of evolution must take into account the relatively unchanging side of nature as well as its measurable or describable transformations; that we should study the relatively fixed background as well as the moving or changing object." A conspicuous feature common to objects in the mineral, plant, and animal kingdom is the basic similarity of numerous "adjacent individuals of the same general derivation." To any such group or series of repetitive units the author applies the name "polyisomeres." As examples of polyisomeres are mentioned "a row of graptolites, all the leaves on a tree, or other biologic units; they may be a row of cog-teeth on a zipper, the pebbles in a stratum of conglomerate, or a string of musical notes or drum beats;" and elsewhere are added "daisies, flies, sand grains, chocolate bars, votes, vertebrae and mosquitos." Polyisomerism is commonly exhibited both by *things* and by *events*, and "in nature" and in "the works of mankind." "Differentiated polyisomeres" are called "anisomeres" or "polyanisomeres"—e.g., sacral vertebrae, in which certain basic features of a typical vertebra are either emphasized or reduced.

> How did the world come to be so full of polyisomeres and polyanisomeres? . . . As soon as we realize that any sort of recurrences are in themselves polyisomeres, it follows that the latter must be abundant in a world in which every sunrise starts and every sunset stops or slows down the basal process of photosynthesis in plants; that at every low tide billions of limpets, barnacles and other creatures clamp down on the rocks and remain quiet, without new food until the next tide reaches them. . . . In such a world of both simple and complex recurrences and unexpected conjunctions and emphases it is small wonder that animals, if they are to exist at all, must have various ways of adjusting themselves to recurrent changes in their environment. . . .
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> *E pluribus unum* is the principle of progressive increase, organization and integration. During the course of evolution, as well as of individual development, new characters and units of structure appear at given levels and these units are subsequently combined and made to work together either in further extensions of old organs and functions or in entirely new forms and functions. Undoubtedly the individual animal receives through the interaction of heredity and environment some sort of regulating or adjusting system whereby the dangers which its kind have been accustomed to meet are usually rendered nugatory. From such facts and considerations has arisen the doctrine of holism, . . . which stresses the wholeness, the self-defensive, self-perpetuating reactions

of organic beings. The . . . whole is in one sense really greater than the sum of its parts. . . .

A discussion of changes in anatomic pattern and corresponding changes in function concludes that "by the extremely slow effects of Natural Selection upon chance mutations, the locomotor patterns of the fast-moving terrestrial carnivores were gradually overlaid and replaced by the later swimming patterns of the ancestors of the sea-lion. Thus the habitus of the remote ancestor becomes a diminishing part of the successive heritages of its highly modified descendants." The "divergent pressure of Natural Selection, acting through competition and the environment, upon each animal . . . took part in opening the paths leading from primitive land mammal respectively to dog and sea-lion."

"Through the age-long sifting action of Natural Selection many animals inherit such a configuration of the nervous system that they instinctively prepare far in advance for the oncoming winter, certainly without knowing why they do it; they are merely 'wound up' to do it." Is this apparent foresight truly an instance of "design," or is it merely "preadaptation"? The author regards both man-made designs and "natural designs" as "parallel or convergent results, (a) of the preadaptive nervous system of man, and (b) of the cumulatively adaptive patterns of nature."

As affording a suitable basis for a discussion of "Law *versus* Chance," the author offers this incident:

> An incautious human bather stepping on a sting-ray concealed in the muddy sand may receive an extremely painful wound. . . . The evolution of the sting-ray's weapon was probably well under way in Cretaceous times, when the ancestors of man were arboreal, insectivorous tree shrews, living in the forests well away from the bays in which the sting-rays lurked. . . . Thus the present poisonous effects on man are due to the then long distant and unpredictable intersection or coincidence in later time and space of a then non-existent human foot and a then incomplete sting-ray's sting. . . . No doubt a practically infinite number of prerequisite events and conditions took place in geologic time, leading respectively on one side to the evolution of sting-rays and their stings, and on the other to the evolution of early man and of modern incautious bipedal bathers. [The evolution of the sting and of the bather's foot have alike been] preconditioned by the cumulative effect of repetitive or polyisomerous situations, which have developed more or less rhythmically, as in events determined by recurring sunlight and darkness, by winter and summer, by seasonal times for breeding and not breeding, or for growth and arrest of growth, or for seeking this type of environment or that, and by thousands of others. . . . In so far as similar events occur rhythmically, they increase their chances of meeting *similarly* rhythmical series with which they can cross or intersect. . . . The more often differently conditioned series exist near each other, the greater are the chances for meetings or combinations between them. This is a part of the "kaleidoscope theory" of evolution proposed . . . by the writer. . . . The net result of these considerations is to suggest that newly emergent or creative evolutionary events have not been foreordained but have been preconditioned. . . .
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> Natural "laws" . . . are recognized by man through their effect in causing repetitive, recurrent phenomena. "Chance" is the name for random or unexpected events, due to new or newly observed intersection or collision of different natural laws at a given time or space. Hence "Law" and "Chance" are not mutually exclusive but complementary aspects of natural events or phenomena. . . .
>
> The changing patterns of a kaleidoscope afford various similes of the ways of evolution . . . and so the cosmic kaleidoscope keeps turning round and round, slowly but endlessly dissolving old combinations while creating new patterns, new values, new opportunities.

Volume II, containing a thousand large pages of illustrations, is in itself a monumental achievement. With few exceptions, each "illustration" consists of two or more (usually several or many) figures. The total number of constituent figures—not easily estimated—must run far into the thousands. Excepting a few reproductions of photographs, the figures are line cuts, drawn to a generously large scale. Names of parts are conveniently shown in each figure, and the work is of superior technical and artistic quality. These features combine to make the illustrations vividly intelligible. Especially important is the fact that a large proportion of the illustrations represent *series* of structures or of animals arranged in order of evolutionary relationship—e.g., from crossopterygian to labyrinthodont; pectoral girdle and right humerus from crossopterygian to man; skull from fish to man, etc. Most of the numerous "family trees" are pictorial—i.e., the relationships are shown not merely by branching lines but by a series of pictures of the successive related animals. These pictorial genealogies are vividly instructive. They are, in effect, strips of "movie" film enabling the observer to *see* the evolution in process, the moving being done by the eye instead of by the film. In fact, they are more instructive than an actual "movie" because the observer may, at will, linger at some one stage in the series, or repeat his viewing, or view in reverse. Nor are these series "silent movies." The constituent figures are so lifelike that they "speak for themselves."

The author's literary style ranges from severely conventional anatomic description to a somewhat informal or even "conversational" style in some of his discussions. Occasional passages suggest that his ideas sometimes flow with greater facility than his words, so that a listener would probably interrupt with a request that the sentence be repeated or clarified. A light touch is given to the text by such captions as "The Bivalves—Brainless but Successful" and "The Coelomate Food-Sifters." Among the headings in the chapter on bony fishes appear "Master Wrigglers (Apodes)," "Animated Stone-Crushers (Labroidea)," "Nibbling Angels," "Impetuous Swordfish," "Obese Lump-Sucker," and "Ogling Dragonets."

The reader is never allowed to forget "polyisomerism." The terms related to the concept are too frequently used in situations where the context requires the addition of an explanatory phrase specifying what the polyisomerous structures are, or indicating

whether the anisomerism in question is an instance of differentiation, augmentation, reduction, or some other change. It would usually suffice to mention merely the specific structures or the nature of the modification, leaving it to the reader to recognize the "isomerism," and thereby avoiding making him feel that the concept is being overworked.

It is impossible nowadays for anyone to be an all-round zoologist. He can merely be an embryologist, geneticist, paleontologist, or any other one of many "-ists." If a paleontologic author introduces into his work some histologic, embryologic, or physiologic details, he does so at some risk. It is fair to say that a few of the author's statements about integumentary organs are open to question. Especially so is his oft-repeated statement that the scales of teleosts are horny (see pp. 104, 116, 151, 344). The brief account of the development of a feather (p. 314) leaves much to the imagination, or even puts imagination on the wrong track. The same comment, with increased emphasis, applies to the development of antlers, as described on page 438. The statement that "the velvet secretes the antler" is followed by "the antler-producing organs act somewhat like the large glands on the face in front of the orbit, but instead of secreting a waxy material, they deposit solid bone." Later the antler-producing organs are referred to as "antler glands." Is there any conceivable relation between antlers, constituted of dermal bone, and sebaceous glands, which are wholly epidermal? On page 247 it is stated that amphibian glands of various kinds are derived from the "deeper layers of the skin," and that some of them "secrete pigments." The glands are epidermal and do not secrete pigment. The statement (p. 345) that sebaceous glands tend to "conserve body heat" is open to question. On page 447 it is asserted that the whole "assemblage" of anatomic parts of a whale is "enclosed and held together by an extremely thick and strong streamlined integument, commonly known as blubber." "Held together" is not a function usually ascribed to skin. The interpretation of scales on a bird's foot as modified feathers (p. 315) raises the question as to whether they are not more likely a direct heritage from reptiles. Did early birds have feathers on their toes?

The description of the structure of the ear (pp. 265, 346) is somewhat sketchy. Otoliths are doubtless somehow concerned in the stimulation of the sensory cells of the ear, but they certainly are *not* "attached" to branches of the acoustic nerve.

The electric organs of *Torpedo* (p. 138) are asserted to have been derived from muscles and nerves of the pectoral fins. The innervation of the electric organs is correctly stated as coming from cranial nerves VII, IX, and X. If derived from pectoral muscles, the innervation should be spinal. The fact that the electric organs lie in close relation to the wall of the pharynx and have cranial innervation clearly indicates their origin from visceral muscles.

It would be of interest to know what ground the author has for proposing that osteoblasts may be produced in localized "centers" and carried thence by the blood or lymph to sites where bones are destined to develop, being somehow "attracted" to the appropriate locality. He seems to favor the idea (proposed by P. E. Raymond *et al.*) that the evolutionary origin of exoskeletons was incidental to a necessity for excreting excessive quantities of calcium and other waste substances at the outer surface of the body—converting a necessity into a virtue, so to speak. Would it not be equally reasonable to propose that animals devised endoskeletons as a profitable way of using excess waste material? The idea would seem to be discredited by the fact that numerous animals, large and small and of all sorts, are devoid of skeletons and yet seem to suffer no embarrassment in disposing of their waste materials.

The author's discussion of the evolutionary status of *Amphioxus* (p. 88) invites comment. He depicts *Amphioxus* as an unfortunately frustrated little creature which might have had a bigger and better brain had not the front end of the notochord been in the way. This calls to mind Wilhelm Roux and his *Kampf der Teile* (1881). But a half-century of experimental embryology teaches us that the conspicuous feature of embryonic development is not competition but cooperation or coordination. The fact that the brain of early reptiles was confined in a rigid bony case did not prevent their descendants from having progressively relatively larger brains, the increase being accompanied by coordinated changes in skull and form of head. If the brain of *Amphioxus* should somehow acquire several hundred thousand additional neurons, its size would not be greatly increased, and relatively small adjustments in neighboring parts would allow for it. *Amphioxus* is very highly specialized and beautifully adapted to a peculiar mode of life. Is it not likely to be "content" to stay where it is and become a "dead end" of evolution?

In the attempt to demonstrate the unity of nature, the author makes various comparisons between actions occurring in living and in nonliving things. In some instances he emphasizes a quite superficial similarity and ignores profound differences. Discussing "Brains as Organs of Futurity," he says (p. 540), "If the weight of mountains be pressing against the rock floor of a tunnel at the bottom of a deep mine, it may buckle up and be squeezed together until it is strong enough to resist the thrusts from the sides. Here is an example of an adjustment without benefit of a nervous system." He goes on to say that rocks, metals, etc., "react" to such "stimuli" as may be exerted upon them by impacts, heat, etc. He finds an analogous reaction in mammalian skin when local pressure or friction causes formation of a horny callus. There is no significant analogy here. The falling of a brick is not a response to a stimulus. When a man slips on ice and falls flat, the event is due to his *failure* to effect sufficiently prompt muscular reactions to the various stimuli caused by the slipping. Sustained local pressure or friction on mammalian skin causes great increase in epidermal activity in the affected area—

proliferation of cells, deposition of keratin, piling up of an abnormal number of layers of cornified cells resulting in a protective thickening of the stratum corneum. All this is truly response to stimulus. Nothing analogous to it occurs in the "squeezed" tunnel. The "adjustment" of the deformed tunnel is not achieved by the tunnel itself. The tunnel *can* do nothing because it *is* nothing, being merely a hole in the mountain. No *new* materials are brought to the scene of damage, whereas in the skin materials derived from food in the digestive tract are carried by the blood to the scene of repair to be used in the production of new cells and more keratin.

Another dubious analogy appears in a brief account of osteogenesis and the adaptive structural peculiarities of bone (p. 178). The account begins thus: "In a crude way the skeleton of any bony fish may be likened to a many-pieced ship made of concrete that has been poured into a mold and allowed to set." Turning then to the development of bone: "A . . . bony precipitate . . . has oozed out from the gland-like osteoblasts into a jelly-like matrix (. . . hyaline cartilage . . .)" which is "confined within limiting walls, such as the periosteal membranes . . . ," etc. Development of a bone could better be likened to the building of a brick wall. The bricklayers are the osteoblasts accurately laying course upon course (bone lamellae)—but the bricks do not "ooze out" from the bricklayers. If the "limiting walls" of the cartilage (perichondrium) are to be likened to the "mold" into which concrete is poured, it must be recognized that the perichondrium is a *living* "mold" which *produces its own "concrete"* in that it is the source of the osteoblasts that deposit calcareous material. As later pointed out by the author, it is a "mold" that spontaneously expands and changes its form as the bone grows. In striking contrast to the concrete mold, it persists as the living periosteum on the surface of the bone and, in event of injury to the bone, it repairs the damage. In short, there is *no significant* analogy between osteogenesis and the shaping of concrete in an inert mold.

The author has confessed to being an "educational hybrid" between Philosophy and Science. The reviewer's educational pedigree contains only a negligible taint of philosophy, and he should not undertake any serious discussion of the author's philosophic views. William James, in one of his informal lectures, said that human minds are of two types, "hard" and "soft." The hard-minded man is a materialist and mechanist; the soft-minded is an idealist and vitalist. The philosophy of *Evolution Emerging,* as set forth in the "Kaleidoscope Theory," should be acceptable to the hard-minded. It is clearly and effectively worked out and should be quite convincing to anyone who is willing to allow himself to be convinced. The soft-minded person will be like the woman in the old saying who, "convinced against her will, is of the same opinion still."

If there is any weak point in the Kaleidoscope Theory, it is in the high degree of efficacy attributed to natural selection. The difficulty which, since the time of Charles Darwin, has perpetually beset the concept of natural selection lies in the fact that, in so many instances, the incipient stages of a potentially "new" organ would seem to have no selective value—i.e., to offer nothing that natural selection could lay hold on. A good case in point is the electric organ of fishes. Could it have any selective value before it had attained such a stage of development as would make it at least slightly disagreeable, if not positively harmful, to potential enemies of its possessor? The transformation of muscle to electric tissue requires radical histologic and functional changes in the muscle. To assume sufficiently numerous successive mutations in the same direction is hardly justifiable.

The cleavage between the "hard" and the "soft" types of human mind is as ancient as philosophy itself and will doubtless persist for long ages to come. Scientific method and our thinking in general involve various assumptions. We have no assurance of their absolute validity. According to the Kaleidoscope Theory, consciousness and mind "emerge" from electrons. But it is perhaps as easy to derive electrons from mind as to derive mind from electrons. We do not really know whether mind is now engaged in *discovering* the universe or has *created* it. Hamlet, Prince of Denmark, may have been mentally askew, but he was both sane and wise when, to Horatio, he made a remark that is pertinent to all our philosophies, "hard" or "soft": "There are more things in heaven and earth, Horatio, than are dreamt of in your philosophy." Whether we regard its plot as likely or not, we are certainly deeply indebted to William K. Gregory for allowing us a view of his masterly production "The Cosmic Cinema."

Book Reviews

De Re Metallica. Reprint. Georgius Agricola; trans. from the 1st Latin ed. of 1556 by Herbert Clark Hoover and Lou Henry Hoover. New York: Dover, 1950. 638 pp. $10.00.

A new edition of the Hoover translation of Georg Bauer's 16th-century treatise on mining, milling, and metallurgy has been an obvious need ever since the original 1912 translation became a collector's item, selling for $100 or more per copy. Although the 1912 volume, printed and bound as nearly as possible like the Latin original, had a market that reflected the Hoover fortunes, it is a historical document that should be of such general interest as to be a sound publishing venture.

Any modern book on mining and metallurgy would not, of course, command much popular attention, but *De Re Metallica* should delight any serious reader, despite the technical character of the subject with which it deals. It is a handbook to guide the prospector, the miner, the mill manager, the metallurgist. It was one of the few technological handbooks on any subject available in 1556; hence it has value as a commentary on contemporary technology and science. It is also a fascinating example of bookmaking and book illustration, of scholarship, and of scientific knowledge and its application in central Europe 400 years ago. For those who may find the Hoover's meticulously technical translation formidable, the profuse illustrations will provide ample temptation and reward for prolonged study of the problems involved in finding, recovering, and processing mineral raw materials in Agricola's day.

Upon the professional miner and metallurgist, the book should have a humbling influence. Without benefit of mechanically powered machines, Agricola's contemporaries knew nearly all the tricks of the trade. The introduction of power has, to be sure, revolutionized the scale of extractive operations and has lowered the grade of ore from which commercial recoveries can be obtained. An industrial civilization has discovered uses for new elements and compounds that were unknown in 1556, and the quantitative requirements of modern industry would have staggered producers to whom a few tons were a respectable output. Yet these 16th-century miners and metallurgists already knew and practiced many of the basic methods and processes of ore and metal extraction. Indeed, it would be a simple assignment to name operations in this country, and especially in the other American republics, where mining and milling techniques are as primitive, and recoveries are as low, as they were in Agricola's time.

Georgius Agricola was a practical scholar, but amid the evidence of his practicality it is important that his scholarship not be overlooked or minimized. He apparently knew firsthand every operation in central Europe and some of those farther afield, and he was reasonably well informed about many that he was unable to visit personally. He was a born textbook writer, and *De Re Metallica* is the best of his several books. A crank on detail, he was a master of exposition, but, even so, he left nothing to chance. Every operation and every mechanical device are delightfully depicted in carefully labeled diagrams that are alive. One is led to suspect that the literacy rate was not too high among the mine and mill managers and foremen, and that the many illustrations were aimed to make the book useful to these people.

The extraordinary excellence of the translation was duly noted when it first appeared in 1912. Mrs. Hoover was then given richly deserved credit for the patient mastery of the medieval Latin in which the original book was written, but the sure touch of the highly competent mining geologist and engineer is no less evident. It represents a perfect collaboration that has made an important book accessible to professional men, historians, and discriminating laymen who will appreciate an authentic insight into the past.

HOWARD A. MEYERHOFF
American Association for the Advancement of Science

Of Societies and Men. Caryl P. Haskins. New York: Norton, 1951. 282 pp. $4.50.

Bold, sweeping, and yet careful, Haskins' book sheds new light on a neglected problem of evolutionary theory—the problem of societies. Darwinian biology and its later genetic modifications provide no satisfactory explanation of the origin and survival of societies as distinct from populations. Simpson's recent and distinguished volume on *The Meaning of Evolution,* for example, ignores the question of societies except with reference to *Homo sapiens.* Haskins has instead followed the tradition of Espinas, W. M. Wheeler, and Allee in realizing that communal existence in varied forms and in countless species, particularly among the insects and in man, offers a profound challenge to evolutionary theory.

He views the emergence of societies as one manifestation of a general earthly trend toward complexity and integration. Societies differ, however, with reference to their mode and degree of integration. First and most widespread is the evanescent family form, in which parents and offspring remain together for a time. Second is the associative form, in which adults come together in loose associations of schools, swarms, flocks, or herds. Third is the integrated form, in which a large population of specialized and interdependent individuals live permanently together. The first two forms are readily explained in evolutionary terms and are compatible with each other. But the third form, according to the author, is hard to explain because it is incompatible with the other two and yet is derived from one or both of them. The author points out that few "missing links" can be found

which represent the transition from the family-associated level to the integrated society, but he thinks he has one in the Philippine Stenogastrine wasps, where the daughters remain at home until mature, and another in the common bumblebee, where the first brood, composed of imperfect females, stays in the nest and cares for subsequent broods which grow into normal adults and depart.

The reason why the integrated society is incompatible with the family-associated form is that, in contrast to the latter, it gives very little scope to the individual. Its member organisms are highly specialized; they have lost functions that would be required of nonsocial organisms, and they resemble parasites (in this case parasites on the community itself), except that the community is composed of them and is hence dependent on their specialized contributions. At the family-associated level, however, the individual adult is a functionally complete and self-dependent creature. Accordingly, the conditions of survival are different for the two levels, which makes the development of the integrated society out of the family-associated level a big and difficult evolutionary step.

This theory sets the stage for the author's integration of human society. The odd thing about human social life is that it is a mixture of all three types—familial, associative, and integrated. Deriving from the loose primate group, it achieves its integrated character by a principle unique to human beings, the principle of cultural transmission, which allows far more rapid diffusion of innovations than does the process of mutation and also permits socially learned rather than structurally determined specialization. But, we are told, the mixture of principles in human society is a mixture of incompatibles. Most of our troubles arise from the fact that, on the one hand, the integrity and independence of the individual have survival value, whereas, on the other, the subordination of the individual is required. The human culture-society is therefore an uneasy balance between these two necessities, the one represented by democracy and the other by totalitarianism.

Whether or not one agrees with all the central argument, the fact remains that it is developed with great skill. The best sections are those which describe and interpret the variegated societal phenomena of the organic world. Such matters as parasitism, "slavery," genetic change, geographical conditioning, and communal interaction are handled with rare insight. Although too little attention is given to primate groups, thus occasionally pushing the argument dangerously close to an analogy between human and insect, the handling of the evolutionary place of the human culture-society is nevertheless striking. In my opinion the author should not have gone on to deal with different kinds of human social organization. Not only is it questionable that these kinds have any real analogues in the nonhuman world, but it is also apparent that, like so many natural scientists when they attempt to deal with our social life, the author grows emotional and moralistic in this part.

The specialist in societies will regret the absence of citations to the literature except in a general bibliography. Yet both he and the general reader will welcome a work of such scope and learning written with marvelous lucidity. An original approach to fundamental problems, it contains some of the most readable descriptive and analytical passages to be found anywhere. Despite its popular form, despite its reliance on brilliant insight rather than systematic rigor, the volume will rank as a classic in the literature of comparative sociology.

KINGSLEY DAVIS

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The New You and Heredity. 2nd ed. Amram Scheinfeld. Philadelphia: Lippincott, 1950. 616 pp. $5.00.

In the author's own words the purpose of this book is

> to sift out from the genetics laboratories and various research fields the outstanding facts about heredity directly applicable to human beings; to present these facts in clear-cut, untechnical language, diagrams and illustrations; to point out what their significance may be to the individual and society, and, wherever there is room for argument, to leave the reader to draw his own conclusions.

The steps and processes by which findings were arrived at were to be largely omitted.

The purpose of the book has been fulfilled. It is a popular book in that it is for people in general, rather than for a select few, and is easy to understand. The style is clear, direct, and even familiar as a result of the frequent use of the pronoun of the second person, popular phrases, and occasional slang, as well as allusions to current events. The reader of the book should not be deceived, however, by the informal journalistic style into thinking that the treatment must necessarily be superficial. The style and the simplified diagrammatic drawings are a technique for making learning as painless as possible.

The author tells us that he started out as a "cub" reporter in Milwaukee in 1918 and spent years in newspaper and radio work; that his need of facts for a work of fiction originally led him to the study of human heredity; and that

> before long I discovered that the findings in this field so completely shattered my own preconceived notions and the ideas held by all but an initiated few, as to obliterate my original plans. I became convinced that the most interesting and important task before me was to acquire as thorough a knowledge of the subject as I could and then communicate what I had learned to others.

The first edition came out in 1939. It had a wide distribution and was translated into a number of European languages. The new edition is extensively rewritten and enlarged by about 50% and contains some new and improved drawings and a number of excellent and highly original photographs. It covers a wide range of topics. In the first few chapters the fundamentals of Mendelian genetics are explained. The bulk

of the book consists of descriptions of many specific human traits, including differences classed as beneficial, deleterious, and neutral in their effects. The treatment of psychological characteristics, including mental diseases, has been extended. The last 150 pages contain chapters on evolution, human races, eugenics, and related problems, and a list of references and an index.

The author evidently has had a remarkably broad and fruitful acquaintance with professional geneticists and medical men, from whom he received much advice and assistance. Individual credit is given to one or more such persons for critically reading most of the chapters. In general the writing shows that care was taken to inform the reader whether statements are to be taken as established facts, as generally accepted theories, or as speculations. The reviewer has noted very few statements that seem to be factual errors or debatable propositions set forth as facts. In a book of such size and range some of these are to be expected.

Contemporary workers on the problem of gene duplication may question the assertion on page 59 that genes reproduce "by dividing and forming two of themselves." So far as the reviewer is aware, the precise method of gene duplication is unknown. On page 126 there is an apparent slip in using the expression "pigmy Hottentots." Although of small stature, the Hottentots are not commonly classed as Pygmies. On page 194 it is stated that Pygmies are found in Africa and Australia and that some tribes of Pygmies are achondroplastic dwarfs. The presence of Pygmies in the Andaman Islands, the Malay Peninsula, New Guinea, and the Philippines is not mentioned. True Pygmies seem not to have been reported from Australia. Published studies of Pygmies indicate that they are not achondroplastic dwarfs, in the usual sense of the term, either morphologically or genetically.

The criticisms are of minor importance. This book is recommended for the general reader on the score of its general soundness, excellence of organization, original features, and extremely readable style. A wide diffusion of the knowledge it contains could be of great benefit to individuals and to society.

EDWARD C. COLIN

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Economic Aspects of Atomic Power. Sam H. Schurr and Jacob Marschak. Princeton, N. J.: Princeton Univ. Press, 1950. (For the Cowles Commission for Research in Economics.) 289 pp. $6.00.

Marschak and Schurr and six collaborators have presented an exploratory study of the possible economic effects of peacetime atomic power. It is a scholarly, well-organized and wide-ranging study, without sensational conclusions. The authors emphasize that it is an exploratory and, therefore, tentative study for two reasons: technological data on atomic power are largely not available (nor existent), and the economic theory of the total economic effect of invention is complicated and imperfect. Nevertheless, this essentially conservative book provides the first serious and well-rounded orientation toward the unseen atomic future and is recommended to those who would have a part in this future.

The book is divided into three major parts. The first, consisting of two chapters, deals with the probable cost and other economic characteristics of atomic power compared with our more conventional energy sources. In Chapter 1 the authors choose a range of costs in which they believe atomic power may fall and examine the other economic characteristics, mainly that stemming from the ready transportability of atomic fuel. In Chapter 2 they present a very useful collection of data on the present characteristics of conventional power that serves to remind us that not all of the future is atomic. A particularly interesting map of the world water-power resources indicates the enormous supply of solar energy in this convenient form but in rather inconvenient location (western and central Africa being particularly notable). This section essentially sets up the question: What would the economic effect be if a power source falling within this range of costs and independent of location were available? The bulk of the book attempts to answer this question. In spite of this larger purpose, most of the initial skirmishing has dealt with the relatively less important, and as yet unanswered, question of the cost of atomic power.

Part Two, examining the detail of the possible economic effect of the new invention, is full of substance and interest. The industries examined include aluminum, chlorine and caustic soda, phosphate fertilizers, cement, brick, flat glass, iron and steel, railroad transportation, and residential heating. Of these, it seems to the reviewer, aluminum, iron, and steel were most significantly affected. For aluminum, the effect might operate on the future locational pattern of the industry rather than on its costs. For iron and steel, the electric smelting branch of the industry might be fostered, and, on a very long chance, the present blast furnace reduction methods might be modified. A great deal of valuable information on operating costs is contained in these 10 chapters. Unfortunately, some of these operation costs have become rather outdated in our recent and violent price changes. In some cases, one could have wished that a fuller treatment of capital costs, to augment the consideration of operating costs, might have been presented. Capital costs per unit of product can influence industrial decisions today quite as strongly as operating costs.

Part Three is a first-order attempt to describe the total economic effect on nations and regions of such a power source including the "sequence of complicated repercussions of one economic sector upon another." Only a "sketch" of this large and difficult problem is claimed by the authors. In comparison with the excellent exposition of the larger parts of the text, this short part deserved a bit more editing.

The whole book represents a reasoned study and,

more than that, an outline for even more work on atomic power and its economic effects. The reader will find that it presents a first picture of the potential usefulness of this aspect of the nuclear engineer's work. No book of equal stature on the subject has yet appeared.

JOHN R. MENKE
Nuclear Development Associates, Inc.
White Plains, New York

The James River Basin: Past, Present and Future. Compiled by the James River Project Committee, Virginia Academy of Science, 1950. 843 pp. Order through Foley F. Smith, Box 1395, Richmond 11, Va. $6.00.

The concept of surveying natural resources within physiographic rather than political boundaries has been aptly exploited by the James River Project Committee. The results are highly satisfactory; in fact, the completeness and generally high caliber of the coverage of each division leave little to be desired. Considering the immense difficulties of consummating the survey, it can boast of few competitors in the United States.

The James River basin is a triangular area extending through the central part of the states from the West Virginia border to Norfolk and the mouth of the Chesapeake Bay. It drains important parts of all the Virginia physiographic subdivisions from mountains to tidewater. Most of the transportation systems, educational institutions, industrial centers, and important cities are found in the basin. Such regions, as a portion of the Dismal Swamp, Allegheny Mountains, fresh and tide waters, are still rich in natural resources despite the inroads of civilization that began in 1607. Prominent scientists, educators, and industrial and social leaders have participated in the compilation of the monograph. Specific chapters, or sections, have been the responsibility of one or two individuals, and their work is accurate and factual. Since the survey has been prepared for laymen and scientists alike, the style in general attempts to be popular, but much of the writing will require more than a cursory examination. The monograph is divided into five major subject headings: Conservation, Recreation, Education; Biological Sciences; Earth Sciences; Mathematical and Applied Sciences; and Industry and Transportation.

I. N. Gabrielson's essay on conservation points out that, in general, all the elements necessary to sound resources management are now present and active in the valley of the James. The recreational aspects of the river, surveyed by R. F. Nelson, are concerned with hunting and fishing, the George Washington National Forest, the Jefferson Forest development, and miscellaneous needs.

Over one third of the huge volume is devoted to the biological sciences. "Botany of the James River Basin," by A. B. Massey, and "Plant Pathology," by S. A. Wingard, are, of necessity, rather general, but are well summarized and have useful bibliographies. The entomological essay, by G. T. French, is devoted almost wholly to history and control of economic pests, with little reference to the actual rich insect fauna of the basin. In addition to the references cited in the text, a bibliography covering insect studies made in Virginia should have been added. The check list and bibliography of the 145 species and subspecies of mollusks, by P. R. Burch, is one of the worth-while contributions from the viewpoint of a zoologist.

E. C. Raney recorded more than 74 kinds of freshwater fishes from the James River system. His account is one of the better faunal presentations, with a distributional discussion and complete bibliography. It should prove useful not only to Virginians, but to ichthyologists elsewhere. The section on marine fishes and invertebrates of tidewater, by N. Marshall, covers their economic role and is, unfortunately, too general to be an adequate report on such an important subject. The herpetological section of R. P. Carroll lists the Virginian herpetologists and indigenous amphibians and reptiles. An interesting photographic reproduction of an albino pilot blacksnake is given. A scholarly history of Virginia ornithology with an exhaustive bibliography was prepared by J. J. Murray, and the mammals are well covered by C. O. Handley, Jr., and C. O. Handley, Sr. The survey of medical sciences by M. P. Rucker consists of abundant historical and bibliographic evidence that Virginia's role in American medical science has been outstanding.

The section on earth sciences is divided into: (1) Agriculture, by A. W. Drinkard, Jr.; (2) Forests and Forestry, by C. Jones and associates; (3) Geology, by Marcellus Stow, J. K. Roberts, and associates. The treatment of mathematical and applied sciences consists of essays on the history of astronomy, mathematics, chemistry, engineering, and related subjects, by distinguished scientists of Virginia universities. The section on highway engineering and transportation deals with the industry, and with highway, air, and railroad transportation, emphasizing the established commercial companies. Officials and industrial authorities from these companies have provided the necessary data for this section, often with interesting historical documentation and illustration.

One cannot help but feel that the committee has completed a prodigious task, and they will be admired and envied for their results for years to come. The volume represents "the initial phase of research on the James River basin;" hence we may expect continued studies from the group. Although in the various essays emphasis was to be placed on the *human habitat*, this is not entirely successful. The committee is to be commended, however, for allowing each author to use his own discretion in organizing and writing his paper. They deserve sympathy, on the other hand, when one considers the difficulties involved in arbitrarily selecting subjects to be included and deciding on the amount of space each was to receive. Admittedly, some subjects benefited at the expense of others, and a more uniform treatment of biological subjects would have definite advantages. It is easy to comprehend why such biological forms as algae, fungi, protozoans,

sponges, coelenterates, annelids, arthropods (excluding insects), and nematodes, are hardly mentioned, but lists of these would have served a practical purpose.

The James River Basin is an impressive thick octavo. The text is easily read, and is printed on heavy, high-grade paper; the photographs and maps are reproduced on strong bond paper. The book is bound in heavy blue cloth and is handsomely stamped. The Virginia Academy of Science is to be congratulated on such an excellent contribution to the ever-expanding culture of the South.

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Physics and Mathematics

Introductory Nuclear Physics. David Halliday. New York: Wiley; London: Chapman & Hall, 1950. 558 pp. $6.50.

College texts notoriously suffer from a tendency to conservatism and overemphasis on "classical" developments of historical importance. Too often an author also tries to force a whole field into the mold of a personal point of view. Professor Halliday's book is entirely free from both these faults. It takes the student directly into the spirit of our great new laboratories: up to date in every respect and not unduly concerned with broad unifying principles. A large number of the most modern experimental and theoretical results is presented, on the whole accurately and clearly. Some sections (e.g., chap. 2, sec. 18, and chap. 8, sec. 17) consist of a review of a recent paper in the *Physical Review*, briefly presenting the fundamental knowledge required for its understanding.

The book is divided into 13 chapters and two appendices: an introductory chapter, two on radioactive processes, one each on interaction of radiations with matter, on detecting equipment, on neutrons, on nuclear masses and abundances, on nuclear forces, on accelerating equipment, on nuclear reactions, a separate chapter on fission, one on cosmic rays, and, finally, one on nuclear moments. One appendix is a table of physical constants, the other reviews 6 papers on experimental results which appeared during 1950. Each chapter is divided into about 20 sections and is provided with well-selected and stimulating problems. There are almost 300 illustrations, many of them helpful and relevant. Format, type selection, and paper are unusually pleasing. It would be useful if future editions would list section headings as well as chapters in the table of contents, since some topics do not appear in the most obvious places.

The treatment is weakest in the exposition of basic principles. For example, in the discussion of mass-energy equivalence (chap. 1, sec. 9): "If 1000 cal of heat is added to a block of copper, its mass . . . should increase by 1000 cal divided by the square of the velocity of light." For the beginner this may obscure the significance of c^2 as a factor connecting the units of mass and energy. Similar lapses occur in the discussion of the range of nuclear forces (chap. 8, sec. 5, and elsewhere).

In the presentation of techniques the emphasis is on accurate description of specific instruments rather than on general methods. For example, design data of one particular modern magnetic electron spectrometer are given in considerable detail (chap. 3, sec. 4), but the reader is referred to the literature for a systematic discussion of magnetic focusing.

About 70% of the numerous literature references are to publications that appeared during the past 5 years; over 80% are American. This may lead the less experienced reader to overestimate the significance of progress in experimental technique compared with the selection of important problems. For example, the author index contains only two references to Joliot (one in a historical summary, one to the failure to recognize the neutron). Bothe's name does not appear at all, and Heisenberg is mentioned only once, in passing. Neither Schmidt nor Kopfermann is quoted in the sections on nuclear moments. On the other hand, this reviewer finds *his* name in the index eight times.

The approach should prove most stimulating to a graduate student eager to join the main stream of thought and activity in his chosen field of specialization, particularly if his fundamental training was quite thorough and conservative. It will be less valuable to the beginner, still uncertain about the nature of important progress in physics.

As a textbook in a basic course in nuclear physics the volume must be supplemented by lecture notes explaining the fundamental principles. Its main value will be its use as a source book, providing specific illustrations and problems for the general material of the course.

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The Friction and Lubrication of Solids. F. P. Bowden and D. Tabor. New York: Oxford Univ. Press, 1950. 337 pp. $7.00.

Friction between solid bodies is one of the most basic of physical phenomena—one that affects nearly every phase of human activity. If, on some mythical cosmic control panel, one should pull the switch marked "Friction (Earth)," what a shambles would rapidly ensue. There would lie man, sprawled helplessly on the ground, unable to rise, while much of his physical world, both man-made and natural, would come sliding down about his ears. If, on the other hand, by a simple twist of the wrist one should flip the cosmic rheostat marked "Friction Intensity (Earth)" to "HIGH," the results would be almost equally grim. Civilization would quickly grind to a halt, with much squealing and smoke, and the lubrica-

tion engineer would probably become the most popular man on earth.

Such whimsical imaginings are not a part of the subject matter of this serious-minded and scholarly book. Until a few years ago, they might almost have been as tenable as any of the then-existing theories of friction—so few and sporadic had been the attempts to establish the fundamentals of the friction process. It is truly remarkable that such a basic phenomenon could so long have remained so little explored. However, in recent years the research group for whom the authors speak, together with many of their scientific contemporaries, has attacked the study of solid friction with vigor, so that much of the mystery surrounding this basic occurrence is now being dispelled. Publication of this book marks an important milestone in this belated process.

The book itself, one of the "International Series of Monographs on Physics," is a worthy addition to that series. It is concerned mainly with the basic mechanisms of the processes of friction and lubrication, although it also presents the results of the authors' delvings into many closely bordering fields. It will be of genuine interest and is recommended to all who have a scientific curiosity about basic causes. The general descriptions of the mechanisms associated with friction and lubrication are quite readable, as well as simple and understandable. In addition, the text contains a wealth of valuable detail for all scientists and technical men who require a basic understanding of the many complex factors influencing friction and the action of lubricants. Some of the subjects covered are the area of contact between solids, the surface temperature of rubbing solids, the action of bearing alloys, friction of nonmetals, action of extreme-pressure lubricants, the nature of contact between colliding solids, the nature of metallic wear, and chemical reactions produced by friction and impact. It should be pointed out, however, that the book does not deal with the case or theory of pure hydrodynamic lubrication. Only boundary lubrication (in its broadest sense) is treated.

Admittedly the subject matter is limited rather closely to the findings of the authors' own school of workers. This, however, is no serious drawback, because of the very wide scope of the research carried out by this group and their intelligent interpretation of their own findings and those of certain others—in fact it was almost a physical necessity to limit the scope of the book in this way because of the prolificacy of this group. Surely such a means of summarizing research is far better than publishing a selected collection of papers, since, among other things, it has allowed the authors to temper their earlier findings and opinions with their later judgment. However, as must be the case in any restrictive process, the book does lose some value and broadness of outlook by being confined largely to the research of one group. For example, much of the authors' thinking and interpretations must thereby revolve mainly around a particular type of friction apparatus. The usual main elements of this instrument, of which there are several variations, are a hemispherical (or spherical) slider moving along a flat surface, the slider having a resilient mounting so that "sticking" and "slipping," when they occur, can be observed and readily measured.

The book's subject matter is quite current, with many references to 1949 and 1950 papers, as well as to previously unpublished work. The entire presentation is a shining example of the fact that even today, when the emphasis in science seems to be on superinstrumentation, a wealth of basic information can still be discovered by ingenious experimentation with relatively simple apparatus and techniques. We hope that there can be many more such publications from this group in the future.

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Weltsystem, Weltäther und die Relativitätstheorie. Karl Jellinek. Basel, Switzerland: Wepf & Co., 1949. 450 pp. Sw. fr. 45.

The purpose and scope of this book are very clearly set forth in the introduction. There are many books on relativity, written especially for the layman, and others for the theoretical physicist, but the former are far too superficial, and the latter too mathematical, for the experimental scientist. It is in order to give the experimental scientist an understanding of this theory that this book has been written. A knowledge of differential and integral calculus and the elements of theoretical physics are the only prerequisites.

The fundamental concepts of nonrelativistic physics are first discussed. This includes Newtonian mechanics, emission and wave theories of light, electromagnetic theory, nonrelativistic wave mechanics, including the prerelativistic conceptions of space, time, and the ether. This is followed by a very complete development and discussion of the special theory of relativity, and the modifications that it forces upon the concepts of prerelativistic physics. After a thorough treatment of Einstein's theory of gravitation, and his general theory of relativity, the cosmological theories of Einstein, De Sitter, and the expanding universe are developed. Although the book is not written primarily for the theoretical physicist, he will be interested in many developments that are unlikely to be found in such detail elsewhere in the literature. Among these should be mentioned: (1) a thorough treatment of many so-called paradoxes, (2) the homogeneous gravitational field, and its application to the study of the nonhomogeneous gravitational field, (3) the inhomogeneous field of the sun, and particle orbits in this field, (4) the study of clock synchronization in the case not only of the special theory of relativity but also for the homogeneous field, the inhomogeneous field, and the expanding universe.

The contention that the theory of relativity denies the existence of an ether not only has been shown invalid, but the necessity of a certain type of world ether has been emphasized. However, one might question

Jellinek's argument that the world ether at each locality of space is approximately at rest with the matter in that locality. It would seem to be more in the spirit of the Michelson-Morley and similar experiments, to consider the relative velocity of ether and matter to be a concept without physical significance. Although the argument used, in this case, does not seem at all convincing to this reviewer, he has been unable to find other sections of the book open to similar criticism. The book is written throughout with exceptional clarity of style by an author who shows great understanding and love of his subject, and would be suitable as a textbook either for the classroom or for individual study.

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Negative Ions. 2nd ed. H. S. W. Massey. New York: Cambridge Univ. Press, 1950. 136 pp. $2.50.

This is another of the excellently produced monographs in the postwar series of Cambridge Monographs on Physics—the present one a revised edition of the Cambridge physical tract of the same title. The difference between the original and the revised edition lies mainly in the last chapter, which deals with the role negative ions play in glow discharges and in terrestrial and stellar phenomena.

The book is very lucidly written and one only regrets that the author did not treat some aspects in more detail. In particular, the section dealing with the part theoretical considerations about the continuous absorption by H^- have played, in finally obtaining agreement between the computed and the observed solar spectrum in the visible region, might well have been expanded.

A very valuable innovation one would like to see in all monographs of this kind is a complete bibliography taking the place of the usual author index. From this bibliography it is immediately clear how much work has been done in this field between the publication of the first and the revised editions.

There are two minor points on which I would beg to differ with the author. First, I find it strange to read in a book written by a physicist, who has applied mathematics so successfully to so many physical problems, that mathematics really has no place in a physical tract and should be relegated to small-type sections. Theoretical considerations that, by their very nature, often involve rather complicated mathematics are to my mind just as much part of present-day physics as experiments.

Second, the last paragraph of the book seems to me to be unintelligible to anyone not completely familiar with interstellar problems. In the "hot" interstellar regions where kinetic temperatures of about 10,000° K are reached, all hydrogen is ionized, and H^- is certainly not present. In those regions where H^- is present, the kinetic temperature is only of the order of 100° K, and recent investigations of Spitzer's (*Astrophys. J.*, **109**, 337 [1949]; **111**, 593 [1950]) make it improbable that H^- plays a role at all in the determination of the kinetic temperature.

These points are, however, of small importance, and both the author and the publishers should be congratulated on a book in which one can find practically all relevant information about negative ions.

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Mathematics: Queen and Servant of Science. Eric Temple Bell. New York: McGraw-Hill, 1951. 437 pp. $5.00.

The Main Stream of Mathematics. Edna E. Kramer. New York: Oxford Univ. Press, 1951. 321 pp. $5.00.

Both these volumes are introductions to fundamental mathematical ideas intended for the general reader. Both make plain the relevance of these ideas for natural science; but neither of them places any emphasis upon the narrowly practical values of mathematics, and each is written to appeal to readers with a taste for theoretical understanding and intellectual adventure.

Dr. Bell's present book is an integrated and considerably enlarged version of his earlier *The Queen of the Sciences* (1931) and *The Handmaiden of the Sciences* (1937). No one who has ever seen his publications intended for general audiences need be reminded that he can write on difficult matters clearly, informatively, and entertainingly. He has now composed an inviting introduction to selected, but nonetheless quite numerous, chapters of active mathematical research, and his book undoubtedly opens doors to engrossing mathematical concepts that are not easily accessible to the lay reader. The material is about evenly divided between so-called pure and "applied" mathematics—physics and astronomy being the chief sources for examples of the latter. The longest but not the most successful single chapter is on abstract algebra, much of it inevitably devoted to the definition of key notions. Since few obviously "interesting" theorems are stated and illustrated, the beginner, for whom it is intended, is more likely to be impressed than enthralled. However, none of the remaining chapters suffers from this defect, and to the present reviewer Dr. Bell's account of the theory of numbers and the theory invariants seems especially well done. It is nevertheless a pity that *The Queen of the Sciences* will now be permanently out-of-print. For, although its contents are included in this new book, the smaller bulk of the earlier volume (both in ideas and in physical size) made it a more ideal introduction to the character of modern mathematics, at least for most beginners, than is this fuller presentation of mathematical achievements.

Dr. Bell has definite opinions on a large number of debatable questions, and he does not hesitate to state them vigorously. For example, he does not believe

that mathematical physicists should be given a rigorous course in calculus—apparently because mastery of the subtleties involved in a rigorous treatment may be bought at the price of hamstringing creative minds. Again, he declares the Ptolemaic theory to be one of humanity's major blunders, though it is not clear what the basis for this curious opinion is. He is not a uniformly reliable guide on more philosophical questions concerning the foundations of mathematics. He indicates strong sympathies for the "finitists," although he does not offer even a brief set of reasons for his preferences. Nor is he entirely accurate in his account of Hilbert's final attitude to Goedel's epoch-making discoveries and their consequences for the former's *Beweistheorie*. Hilbert did not declare the latter to be a fiasco, and he did not succumb to the despair concerning this theory with which Dr. Bell credits him.

Dr. Kramer's book is considerably less ambitious in the materials it tries to cover and makes fewer demands on its readers. In fact, it assumes familiarity with nothing beyond high-school mathematics, and explains at some length many things that Bell takes for granted. Despite its smaller scope, the book is nevertheless a useful addition to the literature of "popularized" mathematics; for, although Dr. Kramer employs some of the familiar devices for making novel and difficult matters attractive to large and miscellaneous audiences, her popularization is on a high level. She introduces much of her material partly by way of the personal histories of mathematicians, and she does not neglect to include into her account some of the famous anecdotes and romantic moments in the history of mathematics. Her discussions are pitched on an elementary level, but she manages to convey quite successfully many of the fundamental ideas of such relatively advanced subjects as non-Euclidean geometry, the theory of invariants and relativity theory, the theory of classes and of transfinite numbers, and probability and the theory of experimental design. Her chapter "Science and the Sweepstakes," which deals with probability and statistics, is particularly successful. The book contains many pages of real charm and is uniformly readable and informative.

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Methods in Climatology. 2nd ed. Victor Conrad and L. W. Pollak. Cambridge, Mass.: Harvard Univ. Press, 1950. 459 pp. $7.50.

In its second edition, this book remains the only work in English on climatological methods. Review of the first edition (by Conrad alone) contained a number of suggestions for the inclusion of more modern methods. The authors have adopted only a few of these on the grounds that most of them fall into the first of two classes: "Methods . . . applied to the solution of an *individual* problem" rather than "a *group* of problems" . . . and "are not of general interest." The applied climatologist will not be pleased with these omissions, for all his problems are in this first class. (See review of 1st edition, *J. Am. Statist. Assoc.*, **41**, 249 [June 1946]). However, among the adopted suggestions are the rearranging of chapters in Part I into a more logical order, adding brief discussions of punched cards and degree-days, and adding a new chapter, "Aids to Computation." An entirely new part (II) of over 100 pages, "Computing Devices," has also been included. This consists mainly of a discussion of the evaluation of hidden periodicities and completes the discussion of harmonic analysis of Chapter V. It is difficult to understand why the latter was not combined with Part II. The discussion of periodography is the most thoroughly done section of the book. It will be very useful to meteorologists, although they are cautioned that the discussion does not take into account much modern work done by statisticians in time series analysis.

The book now consists of two main parts as compared to four previously. Part I, called "Methods in Climatology," is essentially the same as in the first edition, with some changes and enlargement. Chapter I consists of general remarks on meteorological observations and errors of measurement. In Chapters II, IV, and V, general statistical methods are covered. It cannot be said that the statistical discussion of these chapters shows much improvement—for it is still largely of an early vintage (1910–20), irrespective of some modern reference citations. Chapter III is on "Aids to Computation," such as graphs and nomograms. It would perhaps have been more logical to place this chapter ahead of the statistical discussion instead of in the middle of it. The applications of statistical methods to climatic elements are considered in Chapters VI and VII. Chapter VIII returns to statistical analysis to discuss "Comparison of Climatic Elements," and Chapter IX is concerned with the application of these methods to specific elements, as well as certain methods of graphical and numerical "characterization." Static and dynamic climatology are very briefly discussed in Chapter X, and some very general remarks on bioclimatology and climatic phenomena are included as well.

In the second part of the book, "Computing Devices (and) Periodography," Chapter XI, entitled "Computation with Mechanical and Electrical Devices," bears a close relationship to Chapter III and could well have been combined with it. The final three chapters are all on the analysis of time series and bear little relation to the preceding chapters.

Readers will again be disappointed if they expect to find in this new edition many methods useful in applied climatology. Through the publication of much wartime work, there has been a great increase in the number of modern methods that fall into the authors' "first class" pertaining to the solution of individual problems. Nevertheless, the second edition is greatly improved over the first and can be recommended as a source book for the classical methods in climatology. It cannot be recommended as a text- or handbook of modern methods.

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Superfluids: Macroscopic Theory of Superconductivity, Vol. I. Fritz London. New York: Wiley; London: Chapman & Hall, 1950. 161 pp. $5.00.

In this volume Dr. London presents a macroscopic theory of superconductivity, which is an extended treatment of the electrodynamic theory he developed with H. London in 1934 to account for the Meissner effect, and subsequently elaborated in 1948. The Meissner-Ochsenfeld experiment emphasized the basic difference between a "perfect conductor" and a superconductor, whereby the former should be characterized by the magnetic induction relation $\dot{B} = 0$ and the latter by $B = 0$ or perfect diamagnetism. Thus the essential reversibility of the transition was established, in harmony with the success of predictions based upon the application of thermodynamics by Keesom and others, and irreversible effects were ascribed to imperfections in the superconductor.

The Meissner effect indicated that there is just *one* well-defined current distribution for a given applied magnetic field, but the theory shows that the assumption of perfect diamagnetism is also unable to account for the facts. The London equations are, in effect, a reduction from those derived for a nonviscous electronic liquid, and take into account the uniqueness of the current distribution.

This is a purely phenomenological theory, although in a final chapter the author draws conclusions from it as to a program for the development of a molecular theory of superconductivity. Daunt and Mendelssohn have drawn attention to the closely analogous behavior of superconductors and liquid helium at temperatures below the "λ-point"; the fundamental idea underlying the macroscopic theory is that the superfluids provide examples of a pure quantum mechanism, with a wave-function of macroscopic scale, and are characterized by a long-range order in the momentum vector. In the case of liquid helium, a possible mechanism for the ordering in momentum space is the condensation of the Bose-Einstein gas, as Dr. London suggested in 1938. On the other hand, the great difficulties inherent in the quantum-mechanical treatment of electronic interactions in metals have so far prevented a successful derivation of the electrodynamical properties of the superconductor. It should be mentioned that recently Heisenberg, Born and Cheng, and Frohlich[1] have all developed molecular theories which lead to a spontaneous current in the lowest energy state, but that London raises the objection that there is no experimental evidence for such a state. The theory of Bardeen, as thus far published, aims at deriving the condition of perfect diamagnetism.

This book, part of the Wiley "Structure of Matter" series, maintains the standard of clear presentation and excellent typography. There are one or two minor text errors, and one feels that a table of the known superconductors with the relevant data would be a welcome addition, even in this essentially theoretical text. The author emphasizes that he has not attempted to achieve complete coverage of the experimental work, but the coverage is generally adequate and references are given in each case.

There are five sections, following an introductory discussion of the general features of low-temperature superflow phenomena and their possible explanation. Part A, the longest section of the book, deals with the basic electrical and magnetic properties of the superconductor and the thermodynamics of the *pure* superconducting state. The fundamental equations are set up and the theory developed to cover a number of simple applications. The choice of these equations is justified by demonstrating how the equations for a perfect conductor must be restricted to cover the case of the superconductor (nonlinear terms being shown to be negligible); then follows further development of the theory, including the energy-momentum and uniqueness theorems. One striking result obtained is that if a rotating sphere be cooled through the transition temperature, it should become magnetized at that point. The magnetization is very small even for very high angular velocities ($\sim 10^{-5}$ gauss at $\sim 10^{4}$ rpm), but it might be possible to confirm the prediction experimentally. The chapter ends with a description of high-frequency measurements of the field penetration depth and an interpretation of the results.

In Part C the author discusses the intermediate state, in Part D the surface energy between the phases and properties of very thin films, and in the final section his "program for the molecular theory of superconductivity." The long-range order of the momentum vector is considered from the viewpoint of quantum kinematics, whence deductions may be made concerning the divergence of the properties of "superelectrons" from those of ordinary free electrons. Superconductivity should result if the eigenfunction of a fraction of the electrons is undisturbed when the system is brought into a magnetic field. What is required is a "condensation" of the average momentum distribution, in contrast to earlier ideas of a freely mobile electronic "crystal" or superlattice.

In the London interpretation, there is no permanent current in an isolated superconductor in thermal equilibrium, except in the presence of a magnetic field. There is no conservation of such currents, but there is a conservation of magnetic flux in multiply-connected superconductors. In order to maintain $B = 0$ the supercurrents adjust themselves to the slightest change of an external applied field, and there is no hysteresis within the limits of the pure superconducting state. Molecular theories which allow a great number of equilibrium states corresponding to different spontaneous currents, and which feature unsymmetric distributions in momentum space without regard for the applied magnetic field or the topology of the system, are rejected.

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[1] In a second paper Frohlich has shown that it is possible to derive the London equations from his theory.

The Theory of Valuations. O. F. G. Schilling. New York: American Mathematical Society, 1950. 253 pp. $6.00.

A valuation is a generalization of the concept of an absolute value. The absolute value $|u|$ of a real or complex number u satisfies the laws

A1: $|u|$ is a real number, $|0| = 0$, $|u| > 0$ if $u \neq 0$.
A2: $|uv| = |u|\,|v|$.
A3: $|u+v| \leq |u| + |v|$.

A rational number $u \neq 0$ will be of the form $u = p^a r/p^b s$ where p is some fixed prime, and r and s are integers not divisible by p. We may define a function $f_p(u) = 2^{b-a}$ for $u \neq 0$ as above and $f_p(0) = 0$. Here the laws are

B1: $f_p(u)$ is a real number, $f(0) = 0$, $f(u) > 0$ if $u \neq 0$
B2: $f_p(uv) = f_p(u) f_p(v)$
B3: $f_p(u+v) \leq \text{Max}\,[f_p(u), f_p(v)]$,

and the third law B3 is definitely stronger than A3. A valuation $V(u)$ is a generalization of this second arithmetical "absolute value" $f_p(u)$ in that we consider a function $V(u)$ with arguments u from a general division ring D and values $V(u)$ in a simply ordered group Γ. Here the laws are

V1: $V(u)$, $u \neq 0$ is an element of a simply ordered additive group Γ. $V(0) = \infty$ is greater than any element of Γ.
V2: $V(uv) = V(u) + V(v)$.
V3: $V(u+v) \geq \text{Min}\,[V(u)\ V(v)]$.

Here for the rational field we may take $V_p(u) = a - b$ with $u \neq 0$ as above; i.e., $V_p(u) = -\log_2 f_p(u)$, and so $V_p(u)$ is in an additive group where $f_p(u)$ was in a multiplicative group. Since the law V3 is stronger than the corresponding triangle law A3, valuations are in general, like V_p for the rationals, bound up with arithmetical properties.

Hensel's theory of p-adic numbers, with its theory of p-adic convergence, threw new light on problems of congruences associated with the ideal theory of algebraic numbers. Similarly the realization that formal power series were sufficient for the study of algebraic curves opened the way to the study of algebraic geometry over general fields. Both p-adic series and formal power series may be regarded as convergent with respect to an appropriate valuation.

By every standard this is an advanced treatise and the reader will find in Appendix II, "Facts about Linear Algebras," a measure of the background required. But one of the most commendable features of the book is the careful way in which the author has indicated at every stage precisely what background is needed. The book is abundantly supplied with remarks and examples which clarify the motivation and give point to the distinctions made in the definitions. Only the absence of an index will cause the reader any regrets.

In a division ring D with a valuation $V(u)$, those u's with $V(u) \geq 0$ form a ring O and those u's with $V(u) > 0$ form a two-sided prime idea P in O. The residue class ring of O modulo P is again a division ring *D*. If D was an algebra over a field F, then *D* will be an algebra over a field *F*. Thus the valuation is an appropriate tool for studying the "local" theory relating properties of D and F to those of *D* and *F*.

The first two chapters are devoted to general theory of valuations, including the completion of D with respect to $V(u)$ as a metric. The next four lead up to local class field theory, the norm residue symbol being defined by means of the Brauer class group for simple algebras. A final chapter is devoted to a study of the structure of complete division rings, regarded as topological algebras with respect to the valuation.

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Chemistry and Biochemistry

Advanced Organic Chemistry. Reynold C. Fuson. New York: Wiley; London: Chapman & Hall, 1950. 669 pp. $8.00.

This is a textbook for graduate students, containing the reactions, syntheses, and concepts of organic chemistry that are really useful in research. The book is not an omnibus volume, but a carefully selected and organized treatment of specifically valuable processes for which yields can be, and are, cited throughout.

The material is not arranged according to homologous series or functional groups, as in most first-year textbooks. Instead, the chapters deal either with certain large classes of compounds, such as hydroxy compounds, halogen compounds, derivatives of carboxylic acids, carbonyl compounds, active methylene compounds, nitro, nitroso, and oximino compounds, amines and amino compounds, azo and diazo compounds, and organic sulfur compounds, or with general reactions or processes. As examples of the latter may be mentioned cleavage of carbon-carbon bonds, aliphatic substitution, organometallic compounds in synthesis, carbon monoxide in synthesis, oxidation, hydrogenation, aromatic substitution, ring closures, conjugate addition and polymerization. This organization gives the student a different viewpoint and permits correlations of reactions and mechanisms.

The useful and fundamental behavior of organic compounds is well presented and very well indexed. The text is full of solid organic chemistry, no descriptive or "essay material" being given. Do not look in this book for stories about vinegar, violets, vitamins, or veronal; but do look in it for all well-known "name" reactions, chelation, isoster concept, vinylogy, Blanc's rule, decarboxylation, telomers, cyclization, acylation, nucleophilic substitution, cyanoethylation, oxo reaction, etc. Reactions important in industry are given, as well as those of theoretical value. Older work is cited by references to *Annual Reports, Chemical Reviews, Organic Syntheses, Organic Reactions,* and *Organic Chemistry,* by Gilman. Specific literature

citations are given to recent work resulting in up-to-date treatment.

The book can be recommended to graduate students and to all research chemists who want a modern and critical evaluation of organic chemistry from the research standpoint.

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Advances in Radiochemistry and in the Methods of Producing Radioelements by Neutron Irradiation. Engelbert Broda. New York: Cambridge Univ. Press, 1950. 152 pp. $2.75.

In the words of the author, this monograph deals primarily with advances since the appearance of the last comprehensive works on radiochemistry, namely, Paneth's *Radioelements as Indicators* (1928) and Hahn's *Applied Radiochemistry* (1936). Actually the coverage does not postdate these books, since the chapters are written with so much historical background that they can be considered to include concise treatment of much of the older as well as the recent work.

The book begins with a discussion of the definition of radiochemistry, which seems appropriate in view of the various viewpoints on this matter. Broda essentially defines radiochemistry as the chemistry of bodies detected through their nuclear radiations, and this certainly seems adequate as a present-day definition. This is consistent with the usage in which the broader term "nuclear chemistry" is used to include the fields of radiochemistry and a number of other areas of nuclear science in which the chemist works and makes his contributions.

Following the introductory material, there are chapters discussing the distribution of tracer quantities between solids and liquids (radiochemical carrying), tracer quantities in gases, and the electrochemistry of radioelements. These are of especial interest to those of us who might be classed as latecomers to the field of radiochemistry, in view of the excellent and compact review of the early work involving natural radioactive substances, in addition to the review of more recent contributions to these areas.

Work on the production of radioelements by nuclear synthesis, largely through neutron irradiation, and the work on nuclear fission from the chemist's point of view are then reviewed, followed by a chapter on new radioelements of special interest, including the neptunium $(4n+1)$ radioactive series, the transuranium elements, other rare or missing radioactive elements (Nos. 43, 61, 85, and 87), tritium, and radiocarbon.

Specific radiochemical effects for chemical excitation due to nuclear reactions are subsequently treated. Only the work on specific effects, such as the Szilard-Chalmers effect, chemical separation of nuclear isomers, and aggregate recoil, is reviewed, whereas the work on indiscriminate action of radiation beyond the immediate neighborhood of the spot of the nuclear reaction—i.e., the subject of radiation chemistry—is excluded. The book concludes with a section describing new developments in the technique of radiochemical measurements. In this area the coverage is not as complete as that throughout the rest of the book, with many of the newer instruments not described at all.

The book is written in a very concise style and is abundant with references to the original literature. It is perhaps too specialized to have a broad interest, but will certainly find its place on the bookshelf of practically all nuclear chemists and of many others in related fields.

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Chemistry and Biology of Proteins. Felix Haurowitz. New York: Academic Press, 1950. 374 pp. $5.50.

In this book, Haurowitz attempts to bring under one cover most of what is known today about the structure, properties, and mode of action of proteins. Because proteins play a role in practically every aspect of modern biochemistry, the author has had to discuss a wide variety of topics. As a result of this diversity, he has been forced in most cases to skim the surface of his subject matter, leaving the interested reader the alternative of reading a large number of original papers, which are included in the bibliography, or else remaining content with brief, one-sentence summaries of fundamental experiments. The book purports to be a textbook of protein chemistry, but unless it is conceded that the aims of modern pedagogy are the instillation of large numbers of facts in the student rather than the elucidation of principles and development of a critical attitude, one would not find this very satisfactory as a textbook. On the other hand, the subject is treated more extensively than is customary in the modern review literature, and so perhaps the author's own words could be used to describe the work most fairly—namely, that this book represents a "uniform outline of the present state of the protein problem."

The book is well written and contains approximately 1,500 references to the original literature. It is relatively free of typographical errors. The main topics discussed are (1) structure of proteins, (2) biological activity of proteins, and (3) biosynthesis of proteins. For the most part these subjects are treated objectively. Topic (1) tended to be too empirical in nature, many unnecessary facts being included (e.g., conditions of a particular fractionation scheme). Topic (2) was handled rather sketchily, but perhaps this was inevitable in view of its ambitious title. Topic (3) was of necessity highly speculative. At times it was difficult to separate Haurowitz's speculations from the experimental conclusions presented in the papers he was discussing. The author, however, has succeeded in gathering and correlating in a systematic manner most of the old and recent experiments which shed

some light on the nature of the protein molecule. Because of this, the book performs a valuable function and can be heartily recommended to anyone interested in the protein problem.

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Fluorine Chemistry, Vol. I. J. H. Simons, Ed. New York: Academic Press, 1950. 615 pp. $12.00.

During the past 30 years, and especially since the beginning of World War II, great strides have been made in the knowledge of fluorine and fluorine-containing substances. The contributors to *Fluorine Chemistry* have given excellent up-to-date reviews of certain areas of this very comprehensive field. There are some duplication and lack of concentration of subject matter, especially on the theoretical aspects of fluorine chemistry, resulting from the multiple authorship. The book is especially recommended for those interested in inorganic fluorides.

In "Nonvolatile Inorganic Fluorides," H. J. Emeleus presents a superb review and discussion of the occurrence, preparation, and properties of the fluorides of many metals. The chemistry of "Volatile Inorganic Fluorides," by A. B. Burg, is likewise very well done. These first two chapters give the reader an excellent summary of the chemistry of the fluorides of the elements, except for the subject matter covered in special chapters. W. Lange has given a very complete review of the art in "The Chemistry of the Fluoro Acids of Fourth, Fifth, and Sixth Group Elements." The preparation and physical properties of "The Halogen Fluorides," by H. S. Booth and J. T. Pinkston, Jr., are adequately covered. However, the discussion of the chemical properties of these substances is brief.

In "Boron Trifluoride" Booth and D. R. Martin have given a good review of their book on the same subject. For general information on the preparation and properties, including catalytic properties of boron trifluoride, the reader will find this chapter adequate. The editor has demonstrated a competent knowledge of "Hydrogen Fluoride" and "Hydrogen Fluoride Catalysis." These chapters not only cite 211 references, but also give a very good discussion of the properties, especially catalytic, of hydrogen fluoride. The principles and technical problems of the "Preparation of Fluorine" have been excellently discussed by G. H. Cady. The review of the literature and the discussion of industrial methods are brief. A concise summary of the "Physical Properties of Fluorine" is given by Cady and L. L. Burger. In an area where the experimental data are so incomplete and contradictory, G. Glockler has provided a worth-while discussion of "The Theoretical Aspects of Fluorine Chemistry" through the use of empirical relationships. "The Action of Elementary Fluorine upon Organic Compounds," by L. A. Bigelow, gives a commendable analysis of the art and limitations in the use of this very reactive reagent.

The most salient feature of "Fluorocarbons and their Production," by the editor, "Fluorocarbons—their Properties and Wartime Development," by T. J. Brice, and "Fluorocarbon Derivatives," by W. H. Pearlson, is the unique and frequently inconsistent system of nomenclature. The reviewer is of the opinion that this system of nomenclature will not be adopted by the American Chemical Society. The sections on fluorocarbons are interesting and instructive. A good but very brief review of the preparation of "Aliphatic Chlorofluoro Compounds," by J. D. Park, is supplemented by a long table listing physical properties of a large number of such compounds. It would require a small volume by itself to completely cover this subject. "Fluorine Compounds in Glass Technology and Ceramics," by W. A. Weyl, is interesting and well done and completes the material to be found in this new treatise.

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The Solubility of Nonelectrolytes. 3rd ed. Joel H. Hildebrand and Robert L. Scott. New York: Reinhold, 1950. 488 pp. $10.00.

In preparing this new edition the authors have drastically revised the 14-year-old second edition and have considerably more than doubled its size.

Molecular and thermodynamic properties determinative or descriptive of solubility behavior are treated at length, and gaseous and solid, as well as liquid solutions, are included. Recent advances in our knowledge of intermolecular forces and of the nature of the liquid state have been fully utilized, as have the results of the very active cultivation of the field of high polymers during the past decade. The latter field, covered in a 50-page chapter, has provided some extreme cases of nonideal solutions—which, however, the authors' theoretical treatment is able to take in its stride. In these solutions the heat of mixing is very small, and the enormous deviations from ideality (e.g., activity coefficients of 10^{-4}!) are due to the highly anomalous entropy of mixing of the long-chain polymer molecules.

A major aim of the book is the semiquantitative prediction of solubilities from the properties of the solvent and solute. Such prediction is now possible in a useful number of cases. The authors, however, are under no illusions about the work still to be done before the numerous exceptions are brought into line. They admit, furthermore, that "if one must know a solubility to one percent, he should measure it."

Physical chemists will be most interested in the theoretical viewpoints developed, whereas the possibility of applying these to make approximate predictions of solubility will appeal to organic chemists and chemical engineers. For metallurgists there is a chapter on liquid and solid solutions of metals. Biologists whose work is concerned with matter at the molecular level may find suggestive the authors' approaches to the behavior of molecules in mixtures.

A review on solutions of nonelectrolytes written by

the authors for the first volume (1950) of the *Annual Review of Physical Chemistry* is reprinted in an appendix.

The book contains a considerable number of misprints and minor errors, but the reviewer noticed none that seriously interferes with understanding. The margins are too narrow for the notations which many users will want to make, and the printing is rather unattractive.

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Carotenoids. Paul Karrer and Ernst Jucker; trans. and revised by Ernest A. Braude. New York: Elsevier, 1950. 384 pp. $8.50.

English-speaking workers will particularly welcome this translation of the 1948 work published in German by the same authors. Moreover, some corrections were made and newer work included in the translation.

The first 100 pages deal with carotenoids in general, with chapters on formation and occurrence of carotenoids in nature, methods of isolation and study, chemical constitution, isomerism, color, and synthesis. The remainder of the book deals with specific pigments. Each major pigment of known constitution is discussed systematically under the headings history, occurrence, isolation, chemical constitution, formation, properties and physical constants, derivatives, and isomers. The hydrocarbon carotenes are discussed first, followed by xanthophylls, carbonyl compounds, and carboxylic acids. Finally, a large group of partially characterized carotenoids is described in the same manner so far as present information permits. The number of carotenoids discussed is over 70. Thus the subject matter is developed in a very orderly manner. It is unfortunate that recent developments regarding *zeta*-carotene and phytofluene are not mentioned.

In the appendix are several reproductions of considerable interest to experimentalists in this field: (1) colored plates showing crystals of 12 different carotenoids and giving the solvent from which they were crystallized, and (2) a section consisting of 28 figures, reproduced from numerous research papers, showing absorption spectra of many carotenoids. Most of these spectra extend well into the ultraviolet region. Comparison would be facilitated if more uniform units of absorption had been employed throughout this series.

An extensive index of vegetable and animal sources precedes the subject index. No author index is given. References are presented copiously throughout the book at the ends of chapters and in many tables. The paper and binding are of good quality, and the printing and structural formulae are very clear and easily read.

Several tables of outstanding value for the student may be mentioned specifically. The structural formulae for all carotenoids of known structures are presented together. Chemical relationships are indicated. Absorption maxima for carbon bisulfide solutions are given for many pigments. Numerous tables and 440 associated references deal with the distribution of carotenoids in nature.

The subject of *cis-trans* isomerism is outlined in a brief chapter, and numerous references are given. This subject is understandably too large for full treatment in this volume. Such isomers are discussed briefly under some of the specific pigments.

Two phases of carotenoid work of the past decade have been neglected in this volume. The increasing significance of genetic relationships relative to possible improvement in the nutritional value of certain food plants through increase of provitamin-A content could well have been discussed briefly. These considerations are also important for studies of carotenoid synthesis and its various steps. It is disappointing to find that spectrophotometric work, especially with regard to absorption coefficients in relation to analytical applications and methods, is not more fully represented in a volume of this coverage. The absorption curves of the collected spectra are in some cases as old as 18 years, having been determined long before the full significance of *cis-trans* isomerism was appreciated. The reader should consult more recent sources for accurate data of this nature. In Fig. 31 the legend is confused.

This book is highly recommended as a very comprehensive reference on the subject of carotenoids. The organization of its subject matter is excellent.

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Organic Syntheses, Vol. 30. Arthur C. Cope, Ed. New York: Wiley; London: Chapman & Hall, 1950. 115 pp. $2.50.

The present volume is a valuable addition to the series of *Organic Syntheses*. In it specific directions are given for preparing the following 41 compounds:

9-Acetylanthracene, 3-aminopyridine, *p*-aminotetraphenylmethane, DL-aspartic acid, benzoylcholine iodide and chloride, *n*-butylacetylene, β-carbethoxy-γ, γ-diphenylvinylacetic acid, chloroacetonitrile, *trans*-2-chlorocyclopentanol, 4,4′-dichlorodibutyl ether, diethyl *cis*-Δ⁴-tetrahydrophthalate, diethyl *cis*-hexahydrophthalate, 1,4-diiodobutane, ethanedithiol, ethylenimine, 5-ethyl-2-methylpyridine, ethyl phenylcyanoacetate, fumaronitrile, glutaric acid, hexahydro-1,3-5-tripropionyl-*s*-triazine, 2-iodothiophene, 2-mercaptobenzimidazole, methanesulfonyl chloride, N-methyl-2,3-dimethoxybenzylamine, 1-methyl-3-ethyloxindole, methyl β-thiodipropionate, 1-naphthaldehyde, *o*-nitroacetophenone, phenylacetylene, *trans*-1-phenyl-1,3-butadiene, α-phenyl-α-carbethoxyglutaronitrile, α-phenylglutaric anhydride, phenylsuccinic acid, 2,3-pyrazinedicarboxylic acid, 1,2,3,4-tetrahydrocarbazole, *cis*-Δ⁴-tetrahydrophthalic anhydride, tetraphenylarsonium chloride hydrochloride, *o*-tolualdehyde, vanillic acid, and vinyl laurate.

In cases where the name of the preparation differs from the *Chemical Abstracts* indexing name for that

compound, the latter designation is given as a subtitle, and the substance is indexed under both names. Inasmuch as this volume begins a new unit of ten volumes, its index includes only compounds described within the volume.

As is the custom in this series, each preparation described has been rechecked in the laboratory of a member of the editorial board; the reader can thus be assured that the product can be obtained in the yield promised without unexpected difficulties. There is a more detailed description of the synthetic procedure than is usually found in the experimental portion of journal papers. The notes following each preparation give the reasons for certain of the experimental precautions, information which is often of considerable value to the student.

In the opinion of the reviewer, the collection of reproducible preparative methods represented by this and previous volumes of *Organic Syntheses* is a commendable project and one of extreme usefulness to organic chemists.

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The Biochemistry of B Vitamins. Roger J. Williams, *et al.* New York: Reinhold, 1950. 741 pp. $10.00.

Each of the four contributing authors to this book has written a section that contains a large amount of information pertaining to the B-complex vitamins. The first section, entitled "Characterization, Distribution, Assay and Biogenesis of B Vitamins," contains an interesting discussion of the definition of these substances. There are some statements in chapter IIA which may need further scrutiny; examples are the finding that ascorbic acid "disappears from the liver after the tenth day" in chick embryos (p. 21), and the footnotes to Tables 1 and 2 stating that "the material given represents the only data on the subject that are available" with respect to the B-vitamin content of whole organisms and human tissues. It is concluded that wheat and brewers yeast are the poorest sources of biotin, which is not in agreement with data published elsewhere (*J. Nutrition*, **23**, 11 [1942]). On page 89, a paragraph on the biogenesis of vitamin B_{12} has apparently been omitted.

A great deal of the published data relating B vitamins to the action of specific enzymes and biochemical reactions is brought together in a useful way in the second section, dealing with the catalytic functions of the B vitamins. There is considerable speculation involving processes in which B vitamins may be concerned by inference—for example (p. 230), "Biotin . . . could function in some fashion in the process responsible for the formation of the unsaturated linkages in the sterol molecules in a manner comparable to its possible function in the formation of the ethylenic linkages in oleic acid."

"The Role of the B Vitamins in Animal and Plant Organisms" is perhaps even more speculative, although the wide scope of the subject matter is excellent. Some of the data illustrated in Figs. 10–14 do not have any experimental basis. Criticism rather than repetition of certain published statements would have been welcomed. Examples of such statements are the unfounded suggestion that a pteridyl aldehyde photofission product could cause undesirable neurological effects in pernicious anemia (p. 296; incidentally, references 174a–174f are missing from the bibliography), as well as the material on "pyracins" (p. 421), and on *p*-aminobenzoic acid "requirement" (p. 327) and "deficiency" (p. 429).

The fourth and most intricate section, bearing the sweeping title "The Comparative Biological Activities of the B Vitamins and Related Compounds," deals largely with antagonist-metabolite relationships. The first two chapters are devoted to an exposition of the author's proposals regarding "inhibition analysis." This is an approach to the study and assay of unknown growth factors by measuring their effect on a specific competitive-analogue-metabolite inhibition of a biological system. The introduction of the term "erythrotin" is probably unnecessary—indeed the author himself alternates between it and "vitamin B_{13}" (p. 475). The third chapter is devoted to an exhaustive summary of the work on *p*-aminobenzoic acid and its antimetabolites, with 432 references, and the next four chapters, dealing with biotin, folic acid, nicotinic acid, and pantothenic acid are no less comprehensive. The concluding four chapters deal with vitamin B_6, riboflavin, thiamine, choline, inositol and their inhibitors.

Typographical errors were noted on pages 89, 123, 182, 193, 206, and 227.

The volume is a comprehensive addition to the reference literature on the B vitamins and will be welcomed by workers in the field.

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Bacterial Polysaccharides: Their Chemical and Immunological Aspects. Martin Burger. Springfield, Ill.: Thomas, 1950. 272 pp. $6.00.

One would assume the intent of this monograph to be the presentation of a critical and up-to-date integration of the knowledge of bacterial polysaccharides of value to the chemist and immunologist. On reading it, it is difficult to decide to what audience it is addressed.

After a very brief introductory chapter, which merely outlines that bacteria elaborate polysaccharides, the author summarizes in a series of chapters the literature covering the well-studied carbohydrate fractions of several groups of bacteria. Specifically, the various coccal organisms, the anthrax bacillus, mycobacteria, vibrio, brucella, hemophilus, and the gamut of the enteric organisms are covered. A chapter devoted to enzyme studies is interposed following consideration of the pneumococci. Here is presented a brief consideration of enzymes acting on bacterial carbo-

hydrates, a few antibiotics of the gramicidin type, and a gesture toward hyaluronidase and similar "mucolytic" preparations. In the chapter devoted to the typhoid bacillus, pyrogen (*sic*) is discussed. An appendix is concerned with technical details for the preparation of selected polysaccharides.

Unfortunately, the book does not represent an up-to-date approach to the subject and is devoted mainly to a summarization of well-known factual material, with unfortunate emphasis on many outdated ideas. There is little critical evaluation, and conflicting information is dismissed with such comment as "more work is needed."

As a compilation of brief, descriptive summaries of investigations on bacterial polysaccharides, to a limited audience, the book has merit; as a critical discussion of the field, it leaves much to be desired.

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The Enzymes: Chemistry and Mechanism of Action, Vol. I, Part 1. James B. Sumner and Karl Myrbäck, Eds. New York: Academic Press, 1950. 724 pp. $13.50.

Two volumes, each consisting of two parts, are planned for this new encyclopedic work on enzymes. In the foreword to this volume, the editors state that it is their aim "to present systematically the accumulated knowledge in the various phases of enzymology as a comprehensive survey which will be the most efficient service both to those already working in the field and to those preparing to enter it." To accomplish this task they have enlisted the aid of 75 scientists in the United States, Europe, and Australia. A total of 77 chapters is planned, each written by one or more individuals and with no one individual an author of more than two chapters. That such a plan leads to a treatise less homogeneous than a book written by one individual is admitted by the editors in their foreword.

Volume 1, Part 1 consists of 19 chapters. The first eight discuss general aspects of enzymes and include treatments of the physical chemistry, chemical kinetics, specificity and inhibition of enzymes. A discussion of the relation of enzymes to genes, viruses, hormones, vitamins, and immunology; the localization of enzymes within the cell; and the adaptive formation of enzymes complete this group of chapters. The remaining 11 chapters deal with enzymes largely concerned in the catalysis of hydrolytic processes involving acetylcholine, phosphoric and sulfuric acid esters, sucrose, glucosides, galactosides, mannosides, thioglycosides, glucuronides, starch, and glycogen. The phosphorolysis of carbohydrates is to be treated in Part 2 of Volume 1.

As one might expect, some chapters are well done and others can be rated only fair. The chief difficulty seems to be in the failure of the authors of certain chapters to treat their subject critically. In these cases, as unfortunately with so many review articles today, an exhaustive recitation of all the findings in the literature seems to be the main goal of the author. On the whole, however, the editors have gathered together a commendable team of writers. The task they have undertaken is a difficult and worth-while one, and there seems little doubt that when the two volumes are completed they will constitute a major source of information for those interested in enzymes.

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Organophosphorus Compounds. Gennady M. Kosolapoff. New York: Wiley; London: Chapman & Hall, 1950. 376 pp. $7.50.

The author has undertaken a difficult task in attempting a comprehensive treatment of this broad field of organic chemistry. Chemists will be grateful, as this reviewer is, for this addition to the literature. The task is made difficult by the extensive literature in the field and the lack of a generally accepted system of nomenclature. For these and other reasons, the chemist working in the field will welcome this volume. To such workers this book is recommended, with certain qualifications, as a valuable addition to previously available treatments: namely, Goddard (Vol. XI, Part III, of Friend's *Treatise*); Courtot in Grignard's *Treatise*; and the volumes of Beilstein, where much of the material is conveniently collected. The general reader will be more exacting than the specialist, particularly in terms of the success with which the author is able to organize the information and to coordinate it. Such readers will find that this volume falls short of achieving this objective.

Dr. Kosolapoff has divided the field into eleven sections, each of which is assigned a chapter. Methods of synthesis of each type are simply listed—running to 25 in one chapter, 33 in another—with no summary listing and in no apparent order. It is necessary to hunt through 26 pages of Chapter 9 and 22 pages of Chapter 7 to find the discussion of a given synthesis. Tables describing specific compounds are given at the ends of the chapters, again according to arbitrary subdivisions, so that it becomes quite annoying to find the listing of a specific compound. The inadequate index and omission of a detailed table of contents accentuate the problem. This lack of adequate organization of the material detracts significantly from the quality of the volume.

The nomenclature adopted by the author is different from other systems, and suffers from lack of a comprehensive comparison. Reference could well have been made to the activities of the committee of the American Chemical Society which is working on this problem. The existing International Union rules and the Beilstein usage should have been quoted.

The reader may find the author's style annoying in its verbosity and misusages. The phrases "formation of a spectrum of derivatives" and "poorly stable" are

used over and over. The use of "monolithic" for basic; "primitive" for simple; "venerable" for long-known; and "fountainheads" for beginnings are examples of misusages. The statement in the introduction that alchemical reactions "might be called heterogeneous in the fullest sense" is meaningless. The statement on page 190 that "The availability of the necessary trioxide is essentially negligible," for which one can substitute "The trioxide is not readily available," is illustrative of many verbose constructions.

Reference is made to recent important developments in this field, with the notable exception of the use of radioactive phosphorus. New insecticides, poisonous fluorides, and techniques in synthesis of naturally occurring phosphate esters are included but are sometimes difficult to find. In general the subject matter is thoroughly covered.

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The Science of Petroleum: Crude Oils, Chemical and Physical Properties, Vol. V, Part I. Benjamin T. Brooks and A. E. Dunstan, Eds. New York: Oxford Univ. Press, 1950. 200 pp. $11.00.

The first four volumes in "The Science of Petroleum" series were published in 1937. Volume V, part I, deals both with new subjects and with several that supplement subjects previously covered. Under such conditions some repetition of material is obviously unavoidable, and Volume V is a substantial contribution to the series. Two further parts are planned to revise the coverage of the chemistry, physics, and chemical engineering of petroleum.

For Section I entitled "Crude Oils," the chapter by H. M. Smith provides excellent coverage of production and reserve data for all major oil fields in the U. S. for 1935–45. The principal characteristics of the crudes are discussed by the states in which they are found, and analytical data are given for crude oils representative of 76% of the total production in 1945. By comparison the chapters on Venezuelan, Saudi Arabian, and Bahrein Island crude oils present very meager data, indeed, possibly because of the sparsity of available information. The chapter on Middle Eastern oils is somewhat better. A brief chapter is included on the evaluation of crude oils and oil stocks that is essentially an introduction to the subject. Although seemingly out of place in a treatise on the science of petroleum, the chapter on economic developments in the petroleum industry is interesting and well written.

The first chapter in Section II, "Chemical and Physical Properties of Petroleum Hydrocarbons," by A. N. Sachanen, covers the methods of separation and determination of the hydrocarbons in petroleum, lists the percentage composition of various fractions from several typical stocks, and describes methods of classifying crude oils. Although there is some overlapping with a later chapter by Rossini, and much material published since 1938 is overlooked, the coverage is extensive and informative. The succeeding three chapters on the chemistry of paraffin naphthene and aromatic hydrocarbons are brief but well-written reviews of developments since 1937. The extensive treatment of the chemistry of olefin and diolefin hydrocarbons is a reflection of the great expansion of knowledge in this area since the previous article in 1938. The excellent chapter by F. C. Whitmore on the mechanism of organic reactions is a welcome addition to the treatise, although a more complete coverage of the mechanisms of *hydrocarbon* reactions would seem desirable. For example, the mechanism of hydrocarbon oxidation is untouched. The article on "Fractionation, Analysis, and Isolation of Hydrocarbons in Petroleum" is a review of the intensive work of the American Petroleum Institute Project 6, principally covering a crude oil from the Ponca City, Oklahoma, field. A chapter on the chemical thermodynamic properties of hydrocarbons summarizes the collection of thermodynamic data made by the American Petroleum Institute Project 44. The final article covers high-pressure vapor-liquid equilibria in cycling operations and should interest production engineers.

This volume is a valuable addition to "The Science of Petroleum" series as well as an essential reference work for libraries. The treatment is very uneven; however, this is almost inevitable in a treatise of such scope. A huge gap remains in the coverage of the science of petroleum, since much recent work on the physical properties of hydrocarbons is untouched. Perhaps later volumes will rectify this situation.

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The Biological Sciences

The Life of Vertebrates. J. Z. Young. New York: Oxford Univ. Press, 1950. 767 pp. $8.50.

The aim of this large book is thus defined by its author: "The present book has gradually grown into an attempt to define what is meant by the life of vertebrates and by the evolution of that life. Put in a more old-fashioned way, this represents an attempt to give a combined account of the embryology, anatomy, physiology, biochemistry, palaeontology, and ecology of all vertebrates."

It cannot be expected, and the author has not claimed, that a single book can really give a full account of such varied aspects of vertebrate life, or even a smoothly balanced summary of all of them. The degree of success is, nevertheless, brilliant. The book is a first-rate account of the functional anatomy and evolution of the vertebrates.

"A glance through the book will show that I have not been successful in producing anything very novel," the author modestly adds. The organization of the text, to be sure, is not a radical departure from such time-honored works as Parker and Haswell.

There is the familiar sequence of types: *Amphioxus*, lamprey, dogfish, trout, frog, lizard, and pigeon, with a discussion of anatomy in fixed order centered on each. The anatomical treatment is, however, unique in the degree in which it is not merely typological, but also broadly comparative, and not primarily topographical but functional. With the exception of the chapter on the lampreys, which ends with inadequate reference to their fossil relatives, each of these anatomical chapters is followed by a separate chapter on the systematics and history of the corresponding major division of chordates. Other chapters treat the adaptive radiation of bony fishes, economic and population studies of fishes, and the behavior of birds.

The functional and evolutionary point of view is shown by such things as good summaries of Lack on "Darwin's finches," of Sanders on learning in goldfishes, of Pumphrey on vision in birds, and of Young on pupillary reactions in fishes—to mention at random just a few examples. Locomotion is particularly stressed throughout and is illumined by concrete details drawn—from among many other sources—from Gray and Harris on fish locomotion and Aymar on bird flight.

Treatment of mammals is abruptly different from that of other vertebrates. Their systematics and history are given in much greater detail (13 chapters, comprising nearly a third of the descriptive text), but there is no general, comparative, and functional account of their anatomy. The systematic discussion is excellent and is enlivened by the author's emphasis on the integral and active nature of the organisms. A second volume on the structure, function, and development of mammals is promised and will be eagerly awaited. The question may be raised, however, whether handling of mammals in the present book along more nearly the same lines as the other classes would not have improved its usability as a teaching aid, at least.

The evolutionary significance of the history of vertebrates is kept constantly before the reader, and a real sense of the majesty and sweep of that history is conveyed. Discussion of underlying principles is strongly conservative. Strict adherence to "statements that can be rigidly demonstrated by the evidence" produces "not . . . a very impressive list of discoveries." Some statements as to evolutionary processes raise doubts. A "tendency . . . for survival . . . leads [sharks] to adopt whatever habits are possible." Other animals "seek out a variety of new habits," and a type of limb "tends to be developed again when needed." At some points there is an implication that natural selection has some bearing, but the student is not told what natural selection is or how it works. Neo-Lamarckism is explicitly repudiated, but the reading list includes Lamarck and not Darwin, and it cites more works by the neo-Lamarckian Wood Jones than by any other author.

"The history of text-books is often dismissed by the contemptuous assertion that they all copy each other—and especially each other's mistakes. Inspection of this book will quickly confirm that this is true"—thus the modest author begins his preface. He has, indeed, copied a few mistakes. It is, for instance, depressing to encounter again an old, often-copied but obviously incorrect diagram of mammalian molar occlusion. Yet such lapses are few, and one of the outstanding virtues of the book is precisely its freshness. The author has thought things out for himself and has also searched out recent work in the whole, tremendous field.

The illustrations are numerous and with few exceptions are clear, accurate, and attractive. The index is eminently usable. Misprints are few and not serious.

All in all, Young's *The Life of Vertebrates* is a major achievement for which all students of life and of vertebrates will be grateful.

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Researches on Fungi: The Sexual Process in the Uredinales, Vol. VII. A. H. Reginald Buller. Toronto, Canada: Univ. Toronto Press; London, Eng.: Geoffrey Cumberlege, Oxford Univ. Press, 1950. 458 pp. $13.50.

To all who are concerned with the behavior of the fungi, the appearance of Volume VII in Dr. Buller's *Researches on Fungi* will be an event of special interest. It has been published under the auspices of the Royal Society of Canada and was edited by G. R. Bisby, who states that the manuscript was practically unaltered. This last, and posthumous, volume closes a lifetime work of ingenious experimentation, and original and lively presentation of the activities of various fungi. It centers about the function of the pycnidia in the rusts, but, in his usual far-ranging manner, Dr. Buller has included a vast amount of detailed information concerning the morphology, cytology, behavior, life cycles, and history of the rusts concerned in his experiments. At times this great weight of detail and the resulting frequent repetition make slow and burdensome reading, but this is partially offset by Dr. Buller's easy-flowing and readable style.

Sexuality in the rusts is interpreted in an unbiased manner without being influenced by previous theory, although this is fully set forth. Dr. Buller considers the function of the pycnidium and the pycnidiospores to be the same in the rusts as that of the oïdia in the Hymenomycetes, or the "spermatia" or "microconidia" in many of the Ascomycetes (therefore, the use of the term pycnidium, rather than pycnium). He does not consider them as male organs or male gametes, for there are no differentiated female cells. He looks upon the pycnidiospores, rather, as carriers of a nucleus, in a heterothallic rust, from one compatible strain to another. He emphasizes the similarity between the distribution of pycnidiospores of the rusts, by insects, and the pollination of flowers in the higher plants. He considers the presence of pycnidia in a rust as

evidence of heterothallism and their absence as evidence of homothallism.

He describes the structure and function of the pycnidia of a number of rusts in full detail, and presents experimental evidence that the pycnidiospores do not fuse with the "receptive hyphae," emerging through the host stomata, but only with the "flexuous hyphae" of the pycnidium.

The text is accompanied by 124 excellent figures, both original and copied from the previous literature, and by a full subject index. The large print facilitates easy reading of the text.

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Genes, Plants and People: Essays on Genetics. C. D. Darlington and K. Mather. Philadelphia: Blakiston, 1950. 187 pp. $4.00.

These genetic essays are not new, and their principal themes are familiar to any who have scanned the pages of *Nature*, or who have read Darlington's *Recent Advances in Cytology*, *The Evolution of Genetic Systems*, or Darlington and Mather's *The Elements of Genetics*. In fact, 11 of the 16 are to be found in *Nature*, the remainder in publications of general accessibility. According to the authors, their essays will serve to introduce the concepts of genetics to the general student, will show especially the interaction of the methods of experimental breeding and microscopy, and have as their purpose the reduction[1] of the foundations of biology to a single system.

These essays were, for the most part, stimulating when they first appeared, but on the whole they have fared badly with time, and assuredly cannot serve as a suitable introduction to genetics for the general student (*v.i.*). There is not, furthermore, the slightest indication that they have or are likely to reduce the foundations of biology to a single system. The essays by Mather are mostly sober and thoughtful discussions of limited problems upon which many of us could agree, although his argument implying that a better understanding of multifactorial inheritance might have forestalled Lysenko's attack on genetics seems far-fetched. Darlington's essays are mostly of a different sort. Their charm lies not in lucid generalization of nature from exacting valuation of experiment, fact, or the discoveries of others (for they generally do not match wide experience), but rather will be remembered for their brilliance, the verve of their often seemingly slanted and eclectic argument, and their marked capacity to create an illusion of plausibility. Indeed we feel, on reading them, as though genes, chromosomes, cytoplasmic agents, metabolic pathways—inheritance in particular and in general—might well have proved just this simple and rational. Sadly, this is not so.

Belling (*Univ. Calif.* (*Berkeley*) *Pubs. Botany*, 17, 75), Stebbins (*Chronica Botan.*, 6, 429), Huskins (*J. Heredity*, 36, 44 *et seq.*), Fabergé and Singleton (*J. Heredity*, 41, 67), and, most recently, Gorer (*Ann. Eugen.*, 15, 277) have dealt incisively with the defects of Darlington's systems and devices of explanation, and the half-truths many of these essays would build into the foundations of biology. It is true that the articles just cited review other works by Darlington and Darlington and Mather. But the substance of these other works is distilled in many of the essays now under review, and the fact remains that their authors have stood impervious to the criticisms of others, unyielding to the evidence of overwhelming contrary fact. There are no notes now appended to these essays covering disputed points; there are no detected changes in point of view or conclusion. Since each author has apparently consented to an unalterable perpetuity of views at variance with fact, we can only conclude that in many respects they have contrived a personal genetics that excludes nonconforming views, and quite apparently stifles their appreciation of a much larger outside world of facts and ideas.

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Comparative Animal Physiology. C. Ladd Prosser, Ed. Philadelphia: Saunders, 1950. 888 pp. $12.50.

This volume was prepared to fill two long-standing needs for a textbook for students, and a source book for investigators. It has been eagerly awaited, since no satisfactory book in the field has been available in English. The text was written by five young physiologists who have been active in research during recent years. They have accomplished a herculean task in reducing the enormous literature of the field to a single volume. C. L. Prosser wrote 13 of the 23 chapters, besides serving as editor, and assisted V. J. Wulff in one. F. A. Brown, Jr., wrote five chapters; T. L. Jahn and V. J. Wulff collaborated on three chapters; and D. W. Bishop wrote one chapter.

Some readers will wonder why certain topics have been included and others excluded. This reviewer regrets the omission of a chapter on animal behavior. He believes that the topic deserves more than the casual mention it receives in the four chapters on reception. He also questions the omission of an adequate review of general chemical reception in view of the thorough treatment of taste and smell. And why was the basic topic of oxidation-reduction omitted,

[1] This reduction is presumably brought about by Darlington's essays on polyploidy (*Nature*, **124**, 62, 98); on meiosis and crossing-over (*Nature*, **127**, 709; *ibid.*, **140**, 759); on chromosome chemistry (*Nature*, **149**, 66); on race (*Nature*, **152**, 315), and on viruses, so-called cytoplasmic genes, cancer, and disease (*Nature*, **154**, 164; *Discovery*, **6**, 331; *Advancement of Sci.*, **10**, 124). Mather contributes brief accounts of outbreeding and sexuality (*Nature*, **145**, 484; *ibid.*, **149**, 54), multifactorial inheritance (*Nature*, **149**, 427; *ibid.* **151**, 68); restrictions on inbreeding by incompatibility systems in angiosperms and fungi (*Nature* **153**, 392), eugenics and multifactorial inheritance (*R. Coll. Sci. J.*, **14**, 58), genes (*R. Coll. Sci. J.*, **16**, 63) and of the significance of nuclear change in differentiation (*Nature*, **161**, 872). An appendix by Darlington discusses the political destruction of genetics in the Soviet republic.

although a whole chapter is devoted to gaseous oxygen usage? And, finally, why were comparative reproductive mechanisms excluded? Someone will also ask: (1) why the title for Chapter 9—"Respiratory Functions of Body Fluids"—was selected instead of "Blood Pigments," the subject of the chapter; and (2) why Chapter 2 was entitled "Water" only, without including reference to solutions or osmotic relations.

Following each chapter is an alphabetical list of authors referred to in the text by numbers. This is an excellent feature of the book. A total of 3,527 references is listed, which would appear to be adequate. Too often, however, the references are to review articles or to other second- or third-hand summaries instead of to the original papers. This is a dangerous practice since not all reviews are complete or otherwise adequate. The editor's hope, expressed in the preface, that interested readers will trace back the earlier literature will be only occasionally realized.

It is rather unfortunate that the publisher used three different stocks of paper in the book, much of it so thin that the diagrams show through. He also was not always careful to back up the pages correctly, and in Chapter 21 allowed unequal margins at the tops of some 20 pages. Proofreading did not catch the unfinished reference at the end of Chapter 22. For a source book the index could have been considerably expanded to promote quick and ready reference.

In spite of these minor mechanical defects, the book is easy to read and is well illustrated by 312 figures and 78 tables. And in spite of the criticism mentioned above, it is by far the best text of its kind in the English language. No other can even approach it in its coverage and presentation. It will surely find wide usage among biologists. It will also unquestionably stimulate research in animal physiology because of the repeated emphasis put upon the large amount of work remaining to be done.

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The Fresh-Water Algae of the United States. 2nd ed. Gilbert M. Smith. New York: McGraw-Hill, 1950. 719 pp. $10.00.

In view of the current interest in these organisms, the appearance of this second edition is timely. The text has been considerably altered, with the addition of over 100 genera and their illustration. Newly included are the groups Charophyceae, Cryptophyceae, and the Chloromonadales. The first is treated as a second class among the Chlorophyta, and the latter are treated as groups of uncertain systematic position. Professor Smith says of the flagellates, where perhaps the most new material has been added: ". . . with the possible exception of the chloromonads, all the various groups (orders) of flagellates which protozoologists place in the subclass Phytomastigina of the class Mastigophora are phylogenetically connected to organisms of truly algal nature." The algae are assigned to six divisions, and of these he says: ". . . the six divisions . . . represent six kingdoms, all plant-like in nature. . . . The kingdom of the grass-green plants consists of a number of divisions of which the grass-green algae (Chlorophyta) are the most primitive and lead successively to the Bryophyta, Pteridophyta, and Spermatophyta." Many phycologists, and the reviewer, believe these interpretations of the relationships of algae to higher forms to be auspicious expressions of current modern opinion.

Considerable alteration has been made in the order in which the organisms appear through the book. In general this approaches that used in the author's *Cryptogamic Botany,* Vol. I, beginning with the green algae. The very useful ordinal names in the page headings have been excluded, as have the brief characterizations of families and orders that follow the general sections in the older edition. Some changes in terminology are made—e.g., "sporanges" of the earlier edition becomes "sporangia." Some useful literature citations have been dropped from the introduction. The splendid results of H. H. Strain's studies of algal pigments have been included. Several probably false genera have been omitted in the present edition —e.g., *Tetrapedia* Reinsch and *Phytomorula* Kofoid.

The accumulation of observations made since 1933, the date of the first edition, has necessitated alteration in the classification of some genera. One refreshing change is the removal of *Vaucheria* to the Xanthophyceae (Heterokontae), where it appears among the Heterosiphonales. Many of these changes were made to include the recent extensive observations of G. W. Prescott, L. A. Whitford, J. B. Lackey, and, particularly, those of R. H. Thompson. In following the practice of recognizing the Cyanophyta as three orders, one, the Oscillatoriales, is divided into two suborders, Oscillatorineae and Nostochineae. The nomenclaturally preferable *Polycystis* is used in place of *Microcystis.* Accepting *Sphaerella nivalis* (Bauer) Sommerf. (a *Chlamydomonas* in the author's opinion) as the lectotype for the generic name *Sphaerella* necessitated the use of the name *Haematococcus* for the Volvocalean unicells, the protoplasts of which are suspended by strands of cytoplasm from the walls. Similarly, following the type method, the name Haematococcaceae is used for the family in which they are placed.

An expansion of the diatoms might have been expected in view of their currently recognized importance. This section is, however, slightly shortened; mainly through pooling discussions and referring to taxonomic works for listings and characteristics of species, rather than including them in the text.

Although always noted for their workability, the dichotomous keys have been improved, not only by rewriting but by bringing the couplets together, numbering them, and indenting alternate pairs. In this edition, for all genera, there are references to the more recent monographic or taxonomic works where descriptions of all species occurring in the United

States can be found. It was the inclusion of such admirable and useful features that resulted in such a dependable first edition. The author's continuing efforts, as reflected in the present revision, immediately ensure high respect for the thoroughness and accuracy in this even more valuable second edition.

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Chemical Embryology. Jean Brachet. Trans. from 2nd ed. of *Embryologie Chimique,* by Lester G. Barth. New York: Interscience, 1950. 533 pp. $8.00.

Since Joseph Needham published his monumental volumes on the biochemical aspects of embryology in 1931 and 1942, no text of comparable scope and completeness has appeared, and one may doubt that this scholar's stupendous compilatory work will ever be duplicated. Yet, undiscouraged and despite great handicaps during the last war, Brachet has succeeded in writing another *Chemical Embryology* which in its first French edition appeared in 1944 and has now been ably translated and reedited for English readers.

This text travels over much narrower grounds than those covered by Needham. However, being quite up to date and in many respects original in its approach, the book will be welcomed by every embryologist who wishes to integrate biochemical and morphogenetic research. Brachet's qualification for attempting such a synthesis is his own wide experiences in almost every sector of the subject. The author is well aware of the fact that his attempt is bound to suffer from two serious shortcomings: a certain vagueness of our present-day morphogenetic concepts, and a paucity of really well-established and significant data on the chemical processes underlying development. Obvious reasons for this situation are the comparative youthfulness of analytical embryology, the extreme complexity of the processes involved, and absence of a sufficient variety of reliable microtechniques as are required for a comprehensive analysis. In his efforts to master these difficulties Brachet appears quite persuasive. He disposes of the material with facility and imagination, fitting it into a coherent framework of hypotheses that will doubtless stimulate further research. At times, however, one might have liked to see smoothness of presentation sacrificed in favor of a more critical attitude toward both the data and hypotheses coming from the author's own environment and those from other sources.

Chemical Embryology deals in a logical sequence with the phenomena of sex determination, formation of gametes, fertilization, cell division, embryogenesis, and regeneration in vertebrates and invertebrates. Special chapters are devoted to a discussion of the localization and physiological role of nucleic acids and of the induction phenomenon. Whereas the morphogenetic side of these processes is treated rather sketchily, the metabolic aspects are presented in detail. Publications that appeared after 1945 have been considered in this new edition but, unfortunately, are not listed in the bibliography. The illustrations, especially in the chapter on "The Organizer," are of unequal documentary value. Some could be dispensed with since they are based upon doubtful evidence, others discredit rather than support the statements in the text. There will be disagreement over some of the author's conclusions, but altogether the book will be a rich source of information and inspiration both to advanced students and investigators.

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Handbook of Freshwater Fishery Biology. Kenneth D. Carlander. Dubuque, Iowa: Brown, 1950. 281 pp. and appendix. $4.50.

Until the appearance of this handbook, there was no compendium of useful vital statistics on American fresh-water fishes. Dr. Carlander is to be commended; he has earned the gratitude of both present and future fishery biologists.

This pioneer compilation includes some 200 pages of age and growth data, about 10 pages of population information (yield and standing crop), 9 conversion tables, and an extensive bibliography of more than 1,100 titles. The book is thus largely one of age and growth information of certain common fishes.

Carlander's work serves several important purposes. It is an index to most of the published information on the age and corresponding lengths and weights for food, game, and other fishes. Because of its long list of references, it is a source of references on other aspects of the biology of fishes, and it is also a measure of the growth and present status of knowledge in the field.

Chronological analysis of the references cited by Carlander depicts the development of fishery biology (largely on age and growth). Grouped by decades and expressed as percentages, the section in the decade beginning with 1871 amounts to 1.0%; 1881, 1.0%; 1891, 1.9%; 1901, 2.1%; 1911, 4.1%; 1921, 14.1%; 1931, 30.5%; and 1941, 44.7%.

In the recent listing of the better known fishes of the U. S. and Canada (*Am. Fisheries Soc.,* Spec. Publ. No. 1 [1948]), I counted 184 kinds of fresh-water fishes. Discounting the 6 salmons of the West coast, which Carlander does not include, lowers this number to 178. Of these, Carlander shows no information on 57 (about 30.0%) but has found data on 30 others not on the American Fisheries Society list. The handbook gives age and growth information on a total of 151 fresh-water fishes. Classified subjectively, the extent of this information is good on a little less than 25% of the species (essentially sport fishes), fair on about 25% (mostly sport, food, and forage fishes), and poor on more than 50% of those in the list (largely forage, coarse, and "obnoxious" fishes). The present state of knowledge on the age-length relationship is shown to be more advanced for

most species than the frequently more valuable age-length-weight relationship. Young workers should be particularly encouraged by the research opportunities here disclosed.

Because of a sprinkling of clerical and typographical errors, research workers will probably do well to refer to the original papers when using or quoting data from the handbook. When figures are taken directly from Carlander, and the original not seen, this should be made clear.

Fishery specialists are urged to communicate their discoveries of any technical errors or omissions in the literature to the author. Here is such a useful work, prepared at great self-sacrifice, that all should be concerned with its extension, perpetuation, and perfection.

It is hoped that in time additional material may be included. Possibilities are the physical, chemical, and biological constants which express degrees of environmental suitability for fishes. Examples would be limits of temperature, pollutants, and dissolved gases under various conditions. Physiological constants, such as food requirements, blood counts, etc., might also be incorporated. Since treatment of some of these and of other related subjects may appear in the biological handbook of the AIBS, some care should be taken to avoid duplication, and perhaps even to arrange for placement in one source or the other.

I believe that complete alphabetization of the list of references cited would have been worth the considerable extra labor involved. Justification of the present form, however, is seen in the fact that future additions can be made at the end of each letter section, without disrupting the whole, and cross references in the text need not be changed, merely supplemented.

With an expansion of the introductory, explanatory material, the book would have value in the field of conservation education. By such expansion, it could be made as interesting to lay fishermen as it is valuable to the fishery technician and research worker.

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Textbook of Modern Pollen Analysis. Knut Faegri and Johs. Iversen. Copenhagen, Denmark: Einar Munksgaard, 1950. 168 pp. Dan. Cr. 16.00.

Publication of this book in English should prove to be a significant contribution to the development of pollen analysis, or indeed, to the broader subject of palynology.

The authors are well known in European circles, Faegri for his outstanding pollen statistical investigations of Norway, and Iversen for similar studies in his native Denmark, in Greenland, and in other countries. They were students together at the University of Stockholm under the "grand old man of pollen analysis," Dr. Lennart von Post, to whom they dedicate their book.

The authors make it plain that the volume deals exclusively with methods of pollen analysis, not with results. Reports dealing with the results are to be found in the bibliography. This is complete, as the authors say, endeavoring to take into account all literature having reference to pollen analysis up to 1949. This will be welcomed by American students as a key to the European literature.

Pollen analysis started with the work of von Post in 1916. It was quickly taken up by his students in Sweden and later in the other Scandinavian countries, gradually spreading through Europe and the rest of the world. From the middle twenties pollen analysis has been the dominant method for investigating late-Quaternary vegetational and climatic development. It has been perfected into a refined instrument of research, giving surprisingly intimate glimpses into conditions of life during earlier periods.

Pollen analysis hinges on the fact that the outer coat, the exine, of most pollen grains is formed of one of the most extraordinarily resistant materials known in the organic world. Pollen grains can be heated almost to 300° C, or be treated with concentrated acids or alkalis with very little effect on the exine, but it is less resistant to oxidation. The grains are generally excellently preserved in peat and sediments, from which oxygen is largely excluded, even when all other organic constituents are reduced to structureless substance.

Identification of these pollen remains is rendered possible by their highly variable structure, sculpturing, and texture. The authors have illustrated most of the basic forms and used their elements to construct perhaps the most comprehensive and logical key ever published. Yet they point out that "No key, however ingenious . . . can replace the personal knowledge of pollen forms acquired from working with actual preparations." Nevertheless, it is a long step in the right direction. Moreover, the authors have devised a perforated card system keyed to locate the card for the pollen grain wanted, on the basis of its salient features, almost as if they did not quite believe their own words.

Most forest trees produce enormous quantities of pollen which, it is true, may be transported great distances, "but judging from pollen-analytical experience we suppose that the forests beyond the 10 km limit are of very little importance for the ordinary pollen diagram and most of the material will be derived from much nearer sources." This, the authors point out, is because pollen coming from a distance, though it may be abundant, is numerically overwhelmed by that of near-by origin.

There is great variation in the amount of pollen produced by different species; consequently investigators have attempted to discover indices of the relation between the number of pollen grains counted in a deposit and the concentrations of the corresponding species forming the surrounding vegetation. The best control of the representativity of a pollen diagram is obtained, however, by comparing the grains of the

topmost sample with recent conditions. On this basis one can reconstruct the floras of the past with their climatic implications. These are correlated with macrofossils and human artifacts to piece out the prehistory of the human race. Archeological objects may be accurately dated by analysis of the small samples of peat that may adhere to them, provided the pollen diagram for this peat has been adequately studied.

The field of applicability of the methods of pollen analysis is ever-increasing, pertaining not only to fossil pollen—Quaternary, as well as pre-Quaternary—but to recent pollen also, such as honey and hayfever investigations, pollination ecology, glaciology, and even criminal investigations. These methods are brought up to date and clearly and pleasantly set forth in this volume.

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The Care and Breeding of Laboratory Animals. Edmond J. Farris, Ed. New York: Wiley; London: Chapman & Hall, 1950. 515 pp. $8.00.

Those concerned with the maintenance of an animal colony for research or teaching purposes will welcome this book and perhaps wonder why it hadn't been written before. Within its pages is a wealth of information on the housing, caging, breeding, feeding, and some common diseases of several laboratory animals.

The various chapters, contributed by 15 different authors, cover the following species: monkey, rat, mouse, guinea pig, hamster, rabbit, dog, cat, ferret, opossum, domestic fowl, reptiles, amphibia, fishes, and *Drosophila*. The reviewer was particularly impressed with the chapters devoted to the domestic fowl and fishes. In addition, there is a chapter on the control of laboratory pests and parasites of animals.

A considerable portion of the book is devoted to the subject of caging. In this one phase, particularly, it is apparently easy to become an authority, as evidenced by the many modifications described and illustrated. Such minor modifications must keep commercial cage designers busy. It would appear that some standardization of cages would benefit both the animal laboratories and the manufacturers.

The discussions on animal breeding are generally very good. In some chapters mating behavior and physiology of reproduction of the species are described in considerable detail. On the other hand, the genetic aspects of breeding, with one or two exceptions, are treated in a cursory fashion, and the reader will have to search elsewhere for information.

The student of nutrition will not find in this book any great amount of data on this subject. In many chapters the discussion of feeding is primarily concluded with the recommendation to feed a commercial mixed meal or pellet. This advice offers maximum convenience and under some conditions may be adequate. However, there are certainly many conditions where the experimenter will desire more control over this environmental factor that can so largely guide the development of his stock. The reviewer hopes that future editions will present more adequately the wealth of existing information on nutrition for most of the species discussed.

The scattered literature on the common diseases and parasites of laboratory animals has been nicely summarized and is a very useful adjunct.

Many, but not all the chapters offer a useful list of references to more detailed information. The illustrations are plentiful and well reproduced for the most part. A quick search for information is facilitated by a good index.

As a reference book for the experimenter and the student of zoology, this publication should prove most useful.

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The Medical Sciences

The Transmission of Nerve Impulses at Neuroeffector Junctions and Peripheral Synapses. Arturo Rosenblueth. Cambridge, Mass.: Technology Press, M.I.T.; New York: Wiley, 1950. 325 pp. $6.00.

Dr. Rosenblueth's monograph organizes the rather chaotic mass of information and inference regarding the mechanism of interneuronal and neuroeffector communication. It is a lucid and authoritative exposition of the case for chemical transmission at such junctions outside the central nervous system.

The first half of the book is a well-organized and well-documented review of the evidence upon which the theory of chemical transmission in the autonomic neuroeffector junctions is based. It is an up-to-date supplement to Cannon and Rosenblueth's monograph *Autonomic Neuroeffector Systems* (New York: Macmillan [1937]). The theory of sympathins E and I is clearly stated and ably defended. Objections and alternative theories are considered. There is a useful enumeration of the organs supplied by cholinergic and adrenergic fibers, with a résumé of established and controversial points.

This first half of the book provides a logical springboard for the second half, in which the argument for chemical transmission in autonomic ganglia and neuromuscular junctions is carefully developed. Dr. Rosenblueth states at the end of the book that "The argument for chemical transmission at peripheral synapses appears stronger than that which can be made for chemical transmission at autonomic neuroeffector junctions, yet the latter transmission is generally accepted as chemical whereas the former is still considered electrical by many experts in the field." This furnishes the key to an apparent "mission" of the work, namely, to show the parallelisms existing between the two systems (and the differences as well) and thus to develop a firm basis for the inference that

the mechanisms are similar. To the author's credit, it must be stated that he does not permit missionary zeal to obscure his judgment. Even the experts who oppose the theory of chemical transmission should welcome his scholarly presentation of the evidence pro and con. It brings the issues into sharp focus and crystallizes the case for chemical transmission with impressive evidence and compelling logic. Those whom it does not convince it will stimulate, and the latter will find it exceedingly valuable for its spotlighting of the areas of inadequate information.

There is an excellent bibliography of 720 titles. Particular effort was made to provide full documentation of the more controversial issues. Two other admirable features are the fine selection of figures and the concise chapter and section summaries.

Rosenblueth deserves great credit for the clean-cut pattern which he has drawn from heterogeneous data, and for pointing out the places where the fabric is thin. His monograph fills a definite need for such a condensation and evaluation. It is indeed fortunate that the task of preparing such a book was undertaken by one whose own tireless investigations have enabled him to probe the depths of the problem, and whose breadth of vision enables him to place it in proper perspective.

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A Manual of Artificial Radioisotope Therapy. Paul F. Hahn, Ed. New York: Academic Press, 1951. 310 pp. $6.80.

In the applications of radioactive isotopes to clinical therapy, one of the major problems has been the diversity of sources through which the literature has been scattered. This manual is a collection of 14 chapters on pertinent topics in relation to isotope therapy which will be a welcome addition to the library of physicians and radiological physicists in the field. It does not attempt to cover much of the basic material that has been included in several recent volumes on physics, as well as on clinical isotope use. It does give specific and recent data on standards and dosage, practical procedure in the use of radioactive phosphorus, iodine, and gold, and deals with instruments and autoradiography.

As suggested in the definition of this volume as a manual, the subject matter is chosen for immediate application rather than for comprehensive coverage, and it is apparent that much of the material will become outdated quickly. Nevertheless, there is a real need for the book, and it is hoped that revisions will appear at frequent intervals, as our knowledge and practice change.

The first 4 chapters deal with considerations of standards and units, general criteria for choice and use of radioactive isotopes, and internal dosimetry. All presuppose general background knowledge of the field. An excellent chapter reviews the medical indications and techniques of radiophosphorus therapy, and similar excellent coverage is given for radioactive iodine in the diagnosis and treatment of hyperthyroidism and the study and treatment of carcinoma of the thyroid. Two chapters deal with intravenous and direct infiltration uses of colloidal radioactive isotopes, although these are not widely employed as yet. Worth-while chapters are included on therapeutic instrumentation, health physics, autoradiography, procurement, and hospital program planning.

In most instances the contributing authors are outstanding authorities in their fields, and the quality of presentation is generally excellent. Useful tables of certain isotope characteristics are included, although a few more illustrations and tabular data would be desirable in certain instances.

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Toxaemias of Pregnancy: Human and Veterinary. Ciba Foundation Symposium. John Hammond, F. J. Browne, and G. E. W. Wolstenholme, Eds. Philadelphia: Blakiston; London: J. & A. Churchill, 1950. 280 pp. $4.50.

This small book contains 30 formal papers of varying length on the title subject presented at a symposium held January 12–14, 1950. Eighty-seven persons participated in or attended the meetings, largely from the British Empire, although there were several from the Continent and the United States.

It is impossible to review in any detail the great amount of thought and investigation on the toxemias of pregnancy covered in these papers. If we compare the result with a similar effort carried out in Washington, D. C., in 1940, we find marked advances in knowledge and far better editing and potential distribution. To quote the foreword: "Further research, biological, chemical and clinical will doubtless clarify the position. In the meanwhile here is—I think it will be agreed—an excellent basis from which these researches may develop." To this statement I agree. The book should be an essential in every "toxemia-of-pregnancy" library.

Practically every aspect of the subject, scientific and clinical, is covered in a most up-to-date fashion. In the course of these discussions, historical facts of importance prior to 1940 are emphasized. A complete picture of the problem is thus presented. Each article is pointed, not diffuse. This is far from the case with much of the literature.

It is evident that so-called toxemia in cattle is a different disease altogether from that in women, to cite F. J. Browne.

The bulk of the evidence presented seems to incriminate the placenta and/or decidua as the cause of human eclampsism. The exact mechanism, however, is not agreed upon. Possibly all or some of the suggested pathologies are the cause.

Although difficult to select, 3 of the 30 papers are most thought-provoking. Theobald has treated by

morphine only, "between 50 and 60 cases of eclampsia in three years," with two deaths. This includes 7 patients with intercurrent eclampsia (2 with two attacks at an interval of six days) who subsequently gave birth to living babies. This experience gives rise to two questions: Why is there so much eclampsia? Is English eclampsia the same as it is in Boston, U.S.A., or do the women in England react differently?

The second paper of outstanding interest is that by Schneider on "Thromboplastin Complications of Late Pregnancy." This paper offers, by implication, an explanation of incoagulable blood in pregnancy caused by afibrinogenemia—a long-time source of obstetrical mortality only recently found to be curable by fibrinogen therapy.

In the final summary, F. J. Browne shows the impossibility of explaining eclampsism on the basis of the offered theories. He further brings up the need for study of the adrenal cortex hormones in causing toxemia. He concludes with these words: "Some of us have long felt that the problem of eclampsia is beyond the mere clinician, and that it will only be solved by such teamwork as this between physicians, physiologists, endocrinologists and chemists together with an obstetrician to keep his colleagues in touch with the clinical aspects of the problem."

The essayists, editors, and publishers are to be congratulated on this book.

FOSTER S. KELLOGG

Boston, Massachusetts

Structure et Activité Pharmacodynamique des Médicaments du Système Nerveux Végétatif. D. Bovet and F. Bovet-Nitti. Basel, Switzerland and New York: S. Karger, 1948. 849 pp. Sw. fr. 85.–.

D. Bovet and Mrs. F. Bovet-Nitti have been associated for more than a decade with Professor Fourneau at the Institut Pasteur, Paris, and moved a few years ago to the Istituto Superiore di Sanità in Rome. Their main interest has always centered around the structure and pharmacodynamic action of compounds affecting the autonomous nervous system. Due to their outstanding contributions their names are familiar to all investigators interested in the subject. Their book centers around 3 compounds: adrenaline, acetylcholine, and histamine. A great fraction of each section is devoted to the chemical structure of the compounds, their derivatives, analogues, and homologues. From there the authors proceed to the analysis of the pharmacodynamic actions; the correlation with structural modifications and the structural relationship with antagonistically acting compounds are analyzed. Applicability of various compounds and their toxic effects are also described.

This study is an outstanding contribution to the field, and the amount of information given is amazing. There is no other text of this type available. The work is full of original ideas and interesting new facts. In spite of the extraordinarily wide range covered, one never has the feeling of "desk chemistry," but of a presentation based upon great experience and competence derived from experimental work. Of particular interest is the chapter on antihistamines and curare and curarelike compounds. During the past few years both types of compounds have attracted much attention in pharmacological research and medical application. The pioneer work of Bovet in these two fields makes him particularly qualified, and these chapters contain much material that cannot be found elsewhere. For the enzymologist interested in competitive actions, the structural modifications of antagonistically active compounds will be a rich source of valuable information. The physiological implications of some pharmacodynamic actions are only occasionally and very briefly mentioned. Some of the physiological views are not shared by the reviewer. These aspects do not form an integral part of the book, however.

This volume should be in every library and is highly recommended to all investigators in the field.

DAVID NACHMANSOHN

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The Physiology and Pathology of Exposure to Stress. Hans Selye. Montreal, Canada: Acta Endocrinologica, 1950. 1,025 pp. $14.00.

Dr. Selye's theory of stress as the motivating factor in the pathogenesis of a multitude of disorders ranging from arthritis to hypertension, and his concept of the General-Adaptation-Syndrome, as the mechanism of response of the organism to external stimuli, are by now well known. Although propounded some years ago, these theories were propelled to fame by the discovery of the remarkable effects of cortisone and ACTH, and have been widely heralded as offering a theoretical basis for the assumed physiological actions of these drugs. Selye's ideas have been received by many in both scientific as well as lay circles as inaugurating a new era in medical thought and as epoch-making in importance. A smaller, less vocal, but perhaps more critical, group on the other hand has been unwilling to accept the Selye hypothesis as of any fundamental significance and, in fact, feels that the concept is neither new nor enlightening. According to this group, the general adaptation syndrome is no more than Claude Bernard's concept of the constancy of the internal environment or Cannon's concept of homeostasis carried to absurd lengths. The lumping together of arthritis, hypertension, and a host of other disorders on the basis of superficial resemblances is also deprecated. It is true, to be sure, that the same agent (e.g., desoxycorticosterone) may induce an elevation in blood pressure and changes in the fibrous tissue of the joints and in the myocardium. However, the observed rise in pressure does not constitute hypertensive cardiovascular disease, the changes in the joints are not those of arthritis, and the myocardial damage is not acceptable as identical with rheumatic

fever. After all, tissues can respond in only limited ways to damaging influences, particularly when viewed by the relatively crude methods of microscopic anatomy.

Probably only the mellowing effects of time will relegate the concept of stress, as outlined in this book, and the therapeutic and physiologic significance of cortisone and ACTH, upon which in large measure it is predicated, to their proper importance. The critical reader will find much to alienate his admiration; the uncritical and inexperienced reader will be carried away by the extravagance of the author's concepts. Both will agree that Dr. Selye has assembled an astonishing array of apparently unrelated facts. Whether the result is an epoch-making new concept, a hodgepodge of irrelevance, or an interesting survey will undoubtedly be argued for some time. In any case, he has presented his argument with his usual fervor and the liberal use of such neologisms as "Cushingoid," "corticoid," "trophophylaxis," etc., which characterize his prolific writings.

ARTHUR GROLLMAN

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University of Texas

Elements of Bacterial Cytology. 2nd ed. Georges Knaysi. Ithaca, N. Y.: Comstock, 1951. 375 pp. $5.00.

During the past decade interest in bacterial cytology has increased rapidly. Development of the electron and phase microscopes and refined microchemical techniques has led to the contribution of additional knowledge to the already vast volume of literature that followed Cohn's classic work on bacterial morphology.

In 1944 Knaysi presented a concise organization of the information and judgment derived from more than 15 years of study and research on the nature of the bacterial cell. Many valuable but widely scattered descriptions of the structures and behavior of microorganisms were selected to illustrate each aspect of cytology. This second edition has been expanded to include the most recent research on the structure, chemical composition, and motility of the cell. New charts and photographs admirably illustrate the structures referred to in the text. Many unsolved and controversial problems have been presented and discussed by the author, whose contributions in this field eminently qualify him for the task.

Important additions have been made in many sections of the book. The discussion of the variation in the form and size of the bacterial cell during the processes of growth and reproduction presents evidence of cytological differences among microorganisms. There is an entirely new chapter on the chemical composition and structural organization of the cell. The subject of the bacterial nucleus has been more thoroughly presented in the light of recent research. A consideration of the changes in the osmotic pressure of the cells and medium during growth supplements the section on the physicochemical properties of bacterial membranes. The revised chapter on the motion of bacteria discusses both sides of, perhaps, the most controversial question in cytology today. Outstanding electron micrographs show the details of spore germination and greatly increase the value of the chapter on the spores of bacteria. There has been little or no revision of the sections dealing with the cytology of the actinomycetes, spirochetes, and myxobacteria. The author obviously has not attempted to include all the recent literature; however, the student will find the references to earlier work most useful.

The bacterial cytologist encounters many imposing problems in his efforts to observe and explain the nature of living cells. Many of the techniques that have been employed result in important changes that may kill the cells or, at least, alter their activities. Slight modifications in procedures may cause marked differences in the appearance and behavior of the cells, with the resultant lack of agreement among investigators. The straightforward and well-illustrated presentation of the various observations, followed by their considered interpretations, by one of the leaders in bacterial cytology should prove of real value in orienting the reader in a field confused by many conflicting opinions.

Elements of Bacterial Cytology most adequately accomplishes the aim of the author to present a clear concept of the structure of the bacterial cell "according to what is judged to be the best present knowledge."

RUTH LOFGREN

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Scientific Book Register

A Study of Classic Maya Sculpture. Tatiana Proskouriakoff. Washington, D. C.: Carnegie Institution of Washington, 1950. 209 pp.; 111 figures. $5.75 paper; $6.25 cloth.

Genetic Neurology: Problems of the Development, Growth, and Regeneration of the Nervous System and of its Functions. Conference sponsored by the International Union of Biological Sciences. Paul Weiss, Ed. Chicago: Univ. Chicago Press, 1950. 239 pp. $5.00.

The Mountain of Giants: A Racial and Cultural Study of the North Albanian Mountain Ghegs. Carleton S. Coon. Cambridge, Mass.: Peabody Museum of American Archaeology and Ethnology, Harvard University, 1950. 105 pp., 16 figures. $4.75.

Native Orchids of North America: North of Mexico. Donovan Stewart Correll. Waltham, Mass.: Chronica Botanica; New York: Stechert-Hafner, 1950. 399 pp. $7.50.

An Introduction to Universal Serologic Reaction in Health and Disease. Reuben L. Kahn. New York: Commonwealth Fund, 1951. 159 pp. $3.50.

Selected Topics in X-Ray Crystallography from the Delft X-Ray Institutes. J. Bouman, Ed. Amsterdam: North-Holland; New York: Interscience, 1951. 375 pp. $11.00.

Pituitary-Adrenal Function. A symposium organized by the Section on Medical Sciences of the A.A.A.S. and presented at the New York meeting on December 28–29, 1949. Gordon K. Moe, Ed. Washington, D. C.: American Association for the Advancement of Science, 1950. 211 pp. $4.00; prepaid orders from members, $3.50.

Methods of Operations Research. Rev. ed. Philip M. Morse and George E. Kimball. Cambridge, Mass.: Technology Press, M.I.T.; New York: Wiley, 1951. 158 pp. $4.00.

Nutrition and Chemical Growth in Childhood: Calculated Data, Vol. III. Icie G. Macy. Springfield, Ill.: Thomas, 1951. Pp. 1463–2174. $8.00.

The Growth of Physical Science. 2nd ed. Sir James Jeans. New York: Cambridge Univ. Press, 1951. 364 pp. $3.75.

The Behavior of Engineering Metals. H. W. Gillett. New York: Wiley; London: Chapman & Hall, 1951. 395 pp. $6.50.

Physical Methods in Chemical Analysis, Vol. II. Walter G. Berl, Ed. New York: Academic Press, 1951. 640 pp. $13.50.

Principles of Phase Equilibria. F. E. W. Wetmore and D. J. LeRoy. New York: McGraw-Hill, 1951. 200 pp. $3.50.

The Biochemistry of the Nucleic Acids. J. N. Davidson. London: Methuen; New York: Wiley, 1950. 163 pp. $1.75.

Distillation Equilibrium Data. Ju Chin Chu. New York: Reinhold, 1950. 304 pp. $6.00.

Physics: Its Laws, Ideas, and Methods. Alexander Kolin. New York: McGraw-Hill, 1950. 890 pp. $6.50.

The External Secretion of the Pancreas. J. Earl Thomas. Springfield, Ill.: Thomas, 1950. 149 pp. $3.50.

Biochemistry of Glucuronic Acid. Neal E. Artz and Elizabeth M. Osman. New York: Academic Press, 1950. 103 pp. $2.50.

La Combustion du Carbone, XX. Colloques Internationaux du C.N.R.S., Nancy, 27–30 Septembre 1949. Paris, France: Centre National de la Recherche Scientifique, 1950. 128 pp. 1,800 fr.

The Heavens Above: A Rationale of Astronomy. J. B. Sidgwick; American ed. prepared by Warren K. Green. New York: Oxford Univ. Press, 1950. 333 pp. $4.00.

Atlas and Laboratory Manual for the Dissection of the Shark. William Henry Atwood. Minneapolis, Minn.: Burgess, 1951. 40 pp. and 19 plates. $2.00.

Statement on Race. Discussion of the "UNESCO Statement by Experts on Race Problems." Ashley Montagu. New York: Schuman, 1951. 172 pp. $2.00.

Book Review Index

Comments and Communications

Are There Vestigial Structures in Plants?[1]

Structures that have lost their function or have become almost useless are well known in the animal kingdom. For example, there are said to be several score of such structures in man. Their importance in the concept of animal evolution need scarcely be mentioned. The subject has received scant attention in the botanical field and one wonders whether an inquiry into the matter might not prove to be profitable, as well as interesting.

Higher plants have an advantage over most animals in that one finds an alternation of generations in existence, and, furthermore, as one progresses through the several series of the spore-bearing members to the seed plants, there is a decrease in size of the gametophyte and an increase in size of the sporophyte generation. Coupled with this trend is the lessening importance of sex organs (in this discussion the stamens and pistil are not considered to be sex organs). One might look, then, to the spermatophytes for evidences of vestigial organs. It should be stressed at the beginning that facts gleaned from direct observation can seldom be disputed, but hypotheses derived from the observations may be open to question.

If one considers the embryo sac of a typical spermatophyte, one might say that in many cases synergids and antipodals are vestigial. The fact that these structures do function in some species does not invalidate their vestigial nature in other species. It seems to the writer that the entire matter of vestigial organs must be placed upon the species or varietal level. In many plants three of the four megaspores disintegrate and are functionless just prior to their disappearance. The fact that in some species there are no functionless megaspores does not alter the vestigial nature of the megaspores that disintegrate. To draw an analogy from zoology, the caecum with its attached appendix is probably functionless in man, but in birds and some other animals the caecum is of great importance.

Other possible vestigial structures in the higher plants can be mentioned. In many species stipules are clearly reduced and functionless. The stone cells in certain fruits, petiole glands, and abortive carpels in the cherry also belong in this category. Likewise pistils in staminate flowers and stamens in pistillate flowers are vestigial. *Zea mays* shows bisexual initials in both the tassel and the ear.

As one scans the members of the spore-producing groups, one quickly perceives that possible vestigial structures are more difficult to locate. One could mention the glands on fern fronds, the reduced leaves of the horsetail (*Equisetum*), or the paraphyses in the fungi.

Certain tentative principles may be advanced about vestigial organs. One is that the more highly evolved a group is, the more vestigial structures one is likely to encounter. The term "highly evolved" does not mean the oldest geologically but the most diversified and adaptable. The spermatophytes thus display more vestigial structures than the lower groups. The latter are also older geologically and, if selection has operated, useless structures have been culled out to a larger extent than in the seed plants. Vestigial structures seem to be more prevalent among the chordates than in other groups.

No doubt there may be some disagreement with the views herein expressed; but the subject seems to be of too much importance to be ignored, and many fruitful discussions may be initiated in the classroom if the matter of vestigial structures is introduced.

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[1] Contribution No. 33 from the Department of Biological Science, Michigan State College, Lansing.

A Rapid Method for the Measurement of Carbon 14 in Formamide Solution[1]

The methods previously used for the determination of carbon 14 in tracer studies have depended on the oxidation of the material to be tested, followed by measurement of the radioactivity of the resulting carbon dioxide, or by direct measurement of the radioactivity of the material in the solid state. The latter method is complicated by self-absorption, which varies with the character of the substance. To avoid this complication many laboratories convert their materials into barium carbonate and measure the activity with a suitable counter. Because of the difficulty of obtaining a uniformly distributed deposit, the counting rate is not always reproducible. Furthermore, the original material is destroyed, and the procedure is laborious.

We wish to report the use of a rapid-counting method for the direct determination of radioactivity of substances containing carbon 14, employing a suitable solvent, namely, formamide.

A circular 1-ml cell, with an inside diameter of 37 mm and a depth of 1.1 mm, was constructed of stainless steel. The radioactive substance was dissolved in 1 ml of formamide and introduced into the cell. The cell was placed into a methane gas-flow proportional counter[2] attached to a scaling device. After methane was passed through the counter for approximately 10 min, in order to remove the last traces of air, the counting rate became constant, even over a period of several days, and was determined over an appropriate period of time. Generally 40,000 counts were recorded, which corresponds to a standard deviation of $\pm 0.5\%$. Measurements were made on formamide solutions in a concentration range of 0.2–5%. Since the depth of the liquid for counting purposes is "infinitely" thick, the

[1] Aided by a grant from the Atomic Energy Commission.

[2] Nucleometer, manufactured by Radiation Counter Laboratories, Chicago, Ill.

cps is proportional to the carbon-14 concentration in the liquid.

In our apparatus the net cps in formamide, after background correction, amounted to 1.12 ± .01% of the dps, as determined independently by wet oxidation and measurement of the radioactivity of the resulting carbon dioxide by means of a vibrating reed electrometer. Under our experimental conditions this efficiency of 1.12% remained constant over an activity range of 1,000–30,000 dps/ml, and with the following compounds, D-mannonic-γ-lactone-1-C^{14}, barium D-gluconate-1-C^{14}, D-mannitol-1-C^{14}, and a C^{14}-labeled polysaccharide.

A. SCHWEBEL
HORACE S. ISBELL
J. V. KARABINOS

National Bureau of Standards
Washington, D. C.

The Professional Training of College Teachers

IN JUNE 1950 a three weeks' summer school for university teachers was held at the Royal Military College, Kingston, Ontario. This school, which was sponsored by the National Conference of Canadian Universities, was designed to give university teachers an opportunity to improve their teaching techniques and also to discuss some of their common professional problems.

The work was essentially practical, and there were no formal courses. Each student gave brief university lectures, as well as talks to imaginary outside audiences, such as a Rotary Club. The actual listeners, however, were in all cases the other students. Each performance was freely criticized and was also tape-recorded, so that speakers might subsequently hear their own speeches and discuss them with the staff or fellow-students.

Under this friendly criticism, and with guidance from a professor who had had great experience in teaching public speaking, the students made evident progress in the quality of both what they said and how they said it. Every afternoon there were round-table discussions of problems, such as the notes of the lecturer, the notes of the student, setting and marking examination papers, organizing laboratory courses, the use of visual aids, etc.

Some of the students paid their own way, but the majority were sent to the school by their universities. At the end of the course, staff and students unanimously agreed that the experiment should be repeated, and a second school, to be held at McGill University, has been arranged for June 1951. An article describing the first school will appear in the May issue of the British *Universities Quarterly*.

T. H. MATTHEWS

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Zoological Nomenclature and Microfilm

AFTER full discussion and consideration, extending over most of one year, the Joint Committee on Zoological Nomenclature for Paleontology in America (Sinclair, *chairman*), the Nomenclature Committee of the Society of Systematic Zoology (Blackwelder, *chairman*), and a number of zoologists acting as individuals are sending to the International Commission on Zoological Nomenclature the petition that appears below.

It is wisely required that matters being submitted to the International Commission be widely advertised, in order that all interested zoologists may make their opinions known. The sponsors of the petition would appreciate copies of any opinions sent directly to the commission.

PETITION

Within recent years there has arisen, at least in America, a commerce in copies of books or manuscripts photographically reproduced on 35-mm film known as "microfilm." This practice was at first a convenience to scholars, who could thus obtain copies of rare or unobtainable works for study and reference, and the microfilm was usually supplied by large libraries.

From this beginning the practice has expanded, until now not only books but unpublished typescripts are being copied and offered for sale, and microfilm is being advertised as a cheap and convenient method of "publishing" scholarly works which (because of their bulk or their lack of general appeal) would not be readily accepted by a regular publishing house. The distribution and offering for sale of such microfilm is held by some, including high academic officers, to constitute publication.

We ask the commission to rule that, regardless of its status for other purposes, material that is available to the public only in the form of microfilm is not to be considered "published" within the meaning of the *Regles*.

Should the commission prefer to have before them a definite example, may we suggest that the following case be considered:

In 1948 a paper entitled "Pre-Traverse Devonian Pelecypods of Michigan," by Aurele LaRocque, was offered for sale as "University Microfilms Publication 1059;" it consisted of a microfilm copy of a typescript and accompanying plates of photographs. This offering was advertised to an extensive mailing list of libraries and others, and the paper has been available to the public in this form since 1948. In 1950 the same paper was issued in printed form as: *Contributions from the Museum of Paleontology*, University of Michigan, Vol. 7, No. 10, (pp. 271–366, 19 plates). In this paper (in both forms) are described 3 new genera and 14 new species of pelecypods.

We ask the commission to rule that the names of these new taxonomic units are to be ignored until their appearance in printed form in 1950.

G. WINSTON SINCLAIR

University of Michigan

RICHARD E. BLACKWELDER

U. S. National Museum
Washington, D. C.

News and Notes

Symposium on Steroids in Clinical and Experimental Practice

Ralph I. Dorfman
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THE SYMPOSIUM ON STEROIDS was held in Cuernavaca, Mexico, January 15–18. Approximately 70 members were present from the United States, Mexico, Chile, Colombia, Puerto Rico, and Canada; these included active investigators in the clinical and experimental fields of cancer, endocrinology, rheumatology, biochemistry, pharmacology, and physiology, as well as related fields. The principal objective of the meetings was to discuss and evaluate recent laboratory and clinical experiences with steroids, with particular reference to the 11-desoxy steroids—e.g., pregnenolone and progesterone.

That portion of the program dealing with animal experimentation included papers by Hans Selye, L. H. Nahum, C. Chester Stock, and A. Lipschutz. Dr. Selye reviewed the pharmacology of pregnenolone and related 11-desoxy steroids, pointing out that variations in effects of these compounds might occur at different dosage levels. Of the 11-desoxy steroids studied or discussed, Dr. Selye reported that pregnenolone exhibited a marked degree of spermatogenic activity. Desoxycortisone and desoxycorticosterone acetate given to properly sensitized animals produced what Dr. Selye has described as the diseases of adaptation. Dr. Selye also presented evidence that purified growth hormone, or somatotropin, given to experimental animals on a high sodium diet, produces a wide variety of histological lesions in animals. It was suggested that perhaps in diseases in which cortisone and ACTH are contraindicated, a combination of somatotropin and desoxy steroids might have therapeutic benefit.

Dr. Nahum's study was concerned with the effects of progesterone and pregnenolone on the contractility, excitability, and increased excitability and rhythmicity of cardiac muscle. These steroids resemble digitalis in their effects on excitability and rhythmicity and have an opposite effect on contractility.

A screening program for testing the effects of steroids on normal and malignant growth was reported by C. Chester Stock. Inhibition of the development of the chick embryo was most strikingly produced by injection of one of a few of the 11-oxygenated steroids; some of the 11-desoxy compounds were effective in larger doses. A 21-desoxy compound, namely, 21-desoxycorticosterone, was almost as effective as some of the potent 11-oxygenated compounds.

A. Lipschutz described experiments in the screening of steroids with particular reference to their capacity to inhibit the development of estrogen-induced fibromata in guinea pigs. Progesterone proved to be the most potent of the steroids studied.

A. Zaffaroni offered experimental proof for the conversion *in vitro* of cholesterol and pregnenolone to 17-hydroxycorticosterone.

In the clinical field, Roy Hertz presented evidence that progesterone in high doses (250 mg/day) caused regressive changes in carcinoma of the cervix. A. R. Abarbanel discussed clinical data indicating a beneficial effect of pregnenolone in seminal insufficiency.

Konrad Dobriner presented results obtained in studies of the urinary steroid pattern in health and disease, including preliminary evidence that the steroid excretion pattern is altered in rheumatoid arthritis.

Ira Nathanson discussed a program concerned with the screening of steroids and allied compounds in cancer, and George Escher presented studies of the use of various steroids in advanced mammary carcinoma. Recent work with dihydrotestosterone in mammary carcinoma and with methyl androstenediol suggested that both these compounds were worthy of further investigation. Studies of certain other 11-desoxy steroids as possible therapeutic agents in malignant disease held some promise for future developments in this field.

A paper contributed by G. Pincus included a biochemical evaluation of adrenal function in subjects receiving cortisone and pregnenolone therapy.

A number of papers were devoted to studies of the therapeutic value of pregnenolone and other non-11-oxygenated steroids in rheumatoid arthritis, either alone or as adjuvants with subtherapeutic doses of cortisone or ACTH. Favorable subjective or objective effects, or both, in rheumatoid arthritis following pregnenolone therapy were reported by R. A. Davison, H. Freeman, T. McGavack, J. Robles-Gil, and A. Hellbaum. As a result of an extensive clinical study, H. Freeman reported that the extent of the favorable influence of pregnenolone in rheumatoid arthritis was inversely proportional to the age of the patient, the duration of the disease, and the intensity of the signs and symptoms. On the other hand, clinical studies such as those of R. Freyberg and T. S. Danowski indicated little or no objective favorable influence of this steroid, although a general finding of subjective improvement was evident. Paul Holbrook reported that supplementation of daily oral doses of 20–50 mg of cortisone with 800 mg daily of pregnenolone may have therapeutic benefit. A preliminary report on the main-

tenance of the ACTH or cortisone effects in rheumatoid arthritic patients by pregnenolone administration by R. Stecher was indecisive. R. T. Smith presented clinical data indicating that pregnenolone was effective in fibrositis.

In view of the lack of complete agreement as to the efficacy of pregnenolone and related non-11-oxygenated compounds in rheumatoid arthritis, a temporary committee appointed from among members of the conference formulated suggestions for future study. It was agreed generally that both known and new non-11-oxygenated compounds should be studied in greater detail by several groups of investigators using the same experimental conditions insofar as possible. Discussion emphasized particularly the need for studies of the rates of absorption of these steroids after oral and intramuscular administration.

The conference was sponsored by Chemical Specialties Co., Inc., of New York City, and Syntex, S. A., of Mexico City. The Arrangements Committee, consisting of K. Dobriner, P. Holbrook, G. Pincus, E. C. Reifenstein, Jr., I. V. Sollins, and A. White, assisted by a Mexican Subcommittee of J. Robles-Gil, F. Gomez Mont, and F. A. Lehmann, provided excellent facilities for the scientific sessions in addition to a well-rounded social program for the scientists and their wives. The social activities included a reception and dinner in Mexico City in honor of the visiting members, given by the Mexican members of the conference committee; trips about Mexico City and vicinity; a visit to the Floating Gardens of Xochimilco; a visit to the colonial town of Taxco; and a reception and cocktail party at the home of Dr. and Mrs. E. Somlo. Dr. Somlo is executive director of Syntex.

The meetings afforded an excellent means for the exchange of clinical and laboratory information and viewpoints on steroids problems and served further to strengthen the scientific bonds among the United States, Mexico, Latin-American, and South American countries.

Scientists in the News

Gail D. Adams has left the University of Illinois to join the staff of the University of California School of Medicine at San Francisco. He is an associate physicist on the AEC-sponsored project involving biological and medical research with the Medical School's new 70-million electron volt synchrotron. He will be associated with **Robert Stone**, professor of radiology and director of the project.

N. Z. Alcock, D. C. Brunton, and **R. F. Maskell,** former members of the Chalk River Atomic Energy Project, recently founded, together with **P. J. Stewart,** of the Harwell Atomic Energy Project, the first Canadian consulting and engineering firm in the field of radioactivity. The address of this new company is Isotope Enterprises, Oakville, Ont.

J. Milo Anderson, superintendent of Methodist Hospital, Gary, Ind., has been appointed to the position of superintendent of the University Hospital in the new Ohio State University Medical Center. Mr. Anderson also will function as administrator of the new Medical Center and associate professor of hospital administration. Superintendent of Methodist Hospital since 1945, Mr. Anderson formerly was assistant superintendent of the University of Chicago Clinics.

Archie R. Ayers, who recently resigned as dean of Kansas Wesleyan University, has been named president of Detroit Institute of Technology.

Robert F. Bacher, former member of the Atomic Energy Commission, has been named chairman of the Committee on Atomic Energy in the Department of Defense Research and Development Board. Dr. Bacher is head of the Physics Department at the California Institute of Technology. Purpose of the Committee on Atomic Energy, composed of four civilian and six military members, is to assist the RDB in the atomic energy aspects of the military research and development program, and to coordinate the research and development activities of the Department of Defense with those of the AEC.

The 1950 Benjamin G. Lamme gold medal has been awarded by the American Institute of Electrical Engineers to **Donald I. Bohn,** chief electrical engineer of the Aluminum Company of America. Mr. Bohn won the medal "for his pioneering development and application of electrical equipment for controlling rectifying systems in the production of aluminum." Presentation of the medal will be made at the meeting of the institute at Toronto, June 25–29. The medal has been awarded annually for 21 years to an institute member "who has shown meritorious achievement in the development of electrical apparatus or machinery."

Joseph W. Brookhart, geologist assigned to the Salisbury, Md., office of the Ground Water Branch, Water Resources Division, U. S. Geological Survey, has been given charge of the comprehensive groundwater investigations on the Island of Guam, now an Interior Department Administrative Territory. Mr. Brookhart's assignment is for at least a year, probably longer.

Opportunities for in-service training in groundwater and surface-water hydrology provided by the U. S. Geological Survey, Water Resources Division, have been recently utilized by **G. C. Chaterji,** of the Geological Survey of India; **M. D. Chronopoulos, L. D. Kortessis,** and **P. A. Argyropoulos,** hydraulic engineers from Greece; and **Roland DeBlois,** of the Department of Mines, Quebec.

M. R. Clarkson has been named special assistant for defense in the Agricultural Research Administration to fill the vacancy caused by the death of S. A. Rohwer. He will represent the administrator in dealings with the Office of the Secretary, government defense agencies, and industry. As chief of the Divi-

sion of Inspection and Quarantine in the Bureau of Animal Industry, Dr. Clarkson has had a prominent part in directing USDA participation in the fight on foot-and-mouth disease in Mexico. Since September 1949, he has served as a member of the Joint Commission for Eradication of Foot-and-Mouth Disease set up by governments of the two countries.

E. U. Condon, director of the National Bureau of Standards, has been elected an honorary member of the Société Française de Physique, an honor previously accorded to only nine other scientists in the history of the society.

Carter G. Cook, development chemist with the A. C. Lawrence Leather Company, Peabody, Mass., has joined the research staff at Fabric Research Laboratories, Boston, where he will apply his knowledge to problems in textiles and paper technology that involve coating and finishing compounds.

The Washington Academy of Science awards, presented each year to local scientists under 40 years of age in recognition of outstanding achievement in biological, engineering, and physical sciences, have been given to **David H. Dunkle**, associate curator of the Smithsonian Institution, for work in paleontology; **Samuel Levy**, aircraft engineer with the National Bureau of Standards, for distinguished service in structural analysis of aircraft; and **Philip H. Abelson**, a physicist with the Carnegie Department of Terrestrial Magnetism, for his work in chemistry, nuclear physics, and in physics of living organisms. Certificates of merit were also presented to three District high-school pupils: **Cecelia Green**, for her paper on the potential difference of a conducting solution; **Paul E. Condon**, son of E. U. Condon, for his paper on iron-type chemical heaters; and **Donald L. Miller**, for his observation of meteors.

Sidney Farber, professor of pathology, Harvard Medical School, and director of research, Childrens Cancer Research Foundation, Boston, delivered the tenth Edwin R. Kretschmer Memorial Lecture at the Palmer House, Chicago, on the subject "The Effect of Therapy on the Life History and Biologic Behavior of Leukemia."

Harry J. Fuller, botanist, University of Illinois, is lecturing on the current status of "The Emperor's New Clothes, or *Prius Dementat*" (see SCI. MONTHLY, 72, 32 [1951]),[1] before the Phi Beta Kappa chapter at the University of Oklahoma on April 24; before the Wilmington, Del., Ursuline PTA, May 7; and before the Cleveland Regional Council of Science Teachers, October 19.

Martin Goland has been appointed editor of *Applied Mechanics Reviews*. The editorial office of this journal is now located at Midwest Research Institute, Kansas City, Mo.

[1] Free reprints (not more than six to one person) will be supplied by THE SCIENTIFIC MONTHLY until the supply is exhausted.

Emanuel R. Piore, deputy for natural sciences at ONR since 1949, has been appointed deputy and chief scientist to replace Alan T. Waterman. **Randal M. Robertson** will take Dr. Piore's place at the Office of Naval Research.

Chilcott Laboratories, Morris Plains, N. J., has appointed **A. Wayne Ruddy** to its research staff as director of organic chemical research. Dr. Ruddy was formerly associated with Sterling-Winthrop Research Institute.

Howard A. Rusk, director of the Institute of Rehabilitation and Physical Medicine of the New York University–Bellevue Medical Center, has received the 1951 Research Award of the American Pharmaceutical Manufacturers' Association. Dr. Rusk's work has been concerned with the rehabilitation of servicemen who sustained catastrophic injury and crippling, as well as with civilians handicapped from accidents and such paralyzing diseases as poliomyelitis, multiple sclerosis, apoplexy, and cerebral palsy. The Research Award of the APMA was established in 1947, to be presented "in recognition of the work of an investigator who has made a significant research contribution in the field of medicine or the medical sciences." **Bernardo Alberto Houssay, Edwin C. Kendall, Dilworth Wayne Woolley**, and **Selman Waksman** have been the other recipients.

Bernice Weldon Sargent has been appointed assistant director at the Atomic Energy Project at Chalk River to succeed **W. H. Watson**, who was appointed head of the Physics Department at the University of Toronto last year. Dr. Sargent's appointment in charge of the Physics Subdivision is parallel to those of **Andre J. Cipriani**, in charge of the Biology and Radiation Hazard Control Subdivision, and **George C. Laurence**, in charge of the Chemistry and Engineering Subdivision, which is especially concerned with planning the proposed new heavy water reactor, construction of which was recently announced.

The first Albert Einstein Award for achievement in the natural sciences has been won by **Julian Schwinger**, of Harvard University, a mathematical physicist, and **Kurt Godel**, member of the Institute for Advanced Study, Princeton, a mathematical logician. Lewis L. Strauss, president of the Board of Trustees of the Institute, established the award in memory of his parents. The winners will divide the $15,000 prize, and each will receive a medal.

Gobind Ram Seth, formerly associate professor of statistics at the Statistical Laboratory of Iowa State College, is now professor of statistics with the Indian Council of Agricultural Statistics, New Delhi, working with **P. V. Sukhatme**, statistical adviser to the council.

The Department of Defense has announced the establishment of a Meteorological Equipment Committee in the Research and Development Board. **Robert L. Stearns**, president of the University of Colorado,

has been made chairman of the committee, whose members include **Bernhard Haurwitz**, Department of Meteorology, New York University, and **Carl G. Rossby**, professor of meteorology, University of Chicago. **Robert Frye**, of the RDB, will be secretary of the committee.

Max Steineke, chief geological consultant to the Arabian American Oil Company, has been designated as recipient of the Sidney Powers Memorial Medal of The American Association of Petroleum Geologists. Presentation of the gold medal and scroll will be made in St. Louis, April 24, at the 36th annual meeting of the association. Given in recognition of distinguished and outstanding contribution to, and achievements in, petroleum geology, the award publicly acknowledges Mr. Steineke's success in discovering and developing vast oil resources in Saudi Arabia. As the fifth recipient, he joins the ranks of four other distinguished American leaders in the science of petroleum geology: **Wallace E. Pratt** (1945), **Alexander Deussen** (1947), **A. I. Levorsen** (1948), and **E. DeGolyer** (1950).

Ford A. Stinson, of the Soils Department of the Ontario Agricultural College, has resigned to take up the post of director of research for the Tobacco Research Board of Southern Rhodesia. His headquarters will be at Salisbury, and he will direct the work at 5 experiment stations located throughout the area.

As a Sigma Xi national lecturer, **Charles T. Townes**, executive director of the Columbia University Radiation Laboratory, discussed "Spectroscopy in the Microwave Region" at 14 colleges and universities.

Charles W. Turner, professor of dairy husbandry at the University of Missouri, has been granted a Fulbright Award for a year of study and research in New Zealand. He will be on sabbatical leave from September 1 to August 31. He will study at the Ruakura Animal Research Station of the New Zealand Department of Agriculture near Hamilton, and will also give a series of lectures at the Massey Agricultural College.

Utterakara Varavarn, who received his master's degree in ceramic engineering at the University of Washington in December, is the only native of Thailand who is a graduate ceramic engineer. Mr. Varavarn attended the Chulalongkorn University in Bangkok, receiving a degree in geology there in 1947. He came to this country in 1948 and enrolled in ceramic engineering at Washington, doing research on the use of Siamese raw materials in electrical porcelain bodies. A lieutenant in the Siamese Navy, he expects to set up an insulator plant for the Navy Signal Department upon his return to Thailand.

The U. S. Atomic Energy Commission has awarded **Walter S. Wilde**, associate professor of physiology, a lump sum contract to do research at Tulane on fundamental problems involving application of isotopes in physiology. Dr. Wilde will continue to measure the rate of exchange of such body salts as sodium and potassium between muscle, liver, and other tissues and the blood.

Arthur D. Zampella was a guest speaker in a panel discussion on the applications of atomic energy entitled "The Atom and You," held on March 7 at the Jersey City Medical Center under the sponsorship of the Hudson County Medical Society Auxiliary. Dr. Zampella is the consultant on atomic medicine in charge of radiological, bacteriological, and chemical defense for the Jersey City Defense Council. Moderator of the panel was Harrison Martland, professor of forensic medicine at New York University–Bellevue Medical Center and chief medical examiner for Essex County. Other participants included **William S. Maxwell**, USN; **Charles Rosenblum**, chief of the Radioactivity Laboratory of Merck & Co., Inc.; and **Rosalyn Yalow**, of the Radioactive Isotope Unit, Bronx Veterans Administration Hospital.

Bernard Zerbe, for nine years managing editor of *American Druggist*, has become executive editor of the Practical Pharmacy Edition of the *Journal of the American Pharmaceutical Association*. **Samuel Goldstein**, for many years with the Maryland Board of Health, succeeds **Albert M. Mattocks** as acting director of the Laboratory of the A.Ph.A. In this capacity Dr. Goldstein will work closely with **Justin L. Powers**, who directs the work of the revision of *The National Formulary*. To improve the library, museum, and general information services to members of the association, government agencies, and related professional organizations, **Donald B. Crowl**, formerly engaged in public relations activity in the Office of the Surgeons-General of the Army and the Air Force and the publication division of the Mayo Clinic, has been added to the staff.

Raymond E. Zirkle, professor of radiology at the University of Chicago, has been selected to present the spring series of Hitchcock Lectures at the University of California. The six lectures will deal with the general subject "High-Energy Radiation and Mankind."

Colleges and Universities

The **University of Georgia** will dedicate the new laboratories, classrooms, and offices of its School of Pharmacy on May 23. George D. Beal, assistant director of Mellon Institute, will speak at the exercises commemorating the sesquicentennial of the university. His topic will be "Fifty Years of Progress in Pharmacy."

A seminar representing anthropology, sociology, and psychology will meet at **Ohio State** June 15–August 15 to discuss status and stratification. Participants will include Wilfrid Bailey, University of Texas; Nelson Foote, Cornell; Paul K. Hatt, Northwestern; Robert Hess, University of Chicago; and Richard T. Morris, University of Wisconsin. Melvin Seeman, Department of Sociology, OSU, will be co-

ordinator, and the John and Mary R. Markle Foundation will supply funds under a program initiated in 1950 by the Social Science Research Council. Under auspices of the council's Committee on Political Behavior a seminar composed of political scientists and sociologists will begin June 18 at the **University of Chicago**, under the chairmanship of Avery Leiserson. Prospective members include Dayton D. McKean, Dartmouth; Oliver Garceau, Bennington; David B. Truman, Williams; Alexander Heard, University of North Carolina; Samuel J. Eldersveld, University of Michigan; Robert T. Bower, American University; Samuel Huntington, Harvard; Morris Janowitz, Chicago; and Frederick C. Irion, University of New Mexico.

The **University of Texas** Postgraduate School of Medicine will offer a special course in Radiological Physics at the M. D. Anderson Hospital June 18–23. Leonard G. Grimmett, professor of biophysics in the School of Medicine, will be in charge.

New Mexico Institute of Mining and Technology is the new name of the New Mexico School of Mines. It is felt that this name is more in keeping with the work being done at the 62-year-old Socorro institution.

Grants

During the past several years, the faculty of Union College has been experimenting on an informal basis with the concept of course integration. By means of a grant of $75,000 for a five-year period, **Carnegie Corporation** has now made it possible for the college to conduct a complete experiment to determine whether interdepartmental courses will result in a better educational product.

A grant of $60,000 by the **Commonwealth Fund** to the Hunterdon County (N. J.) Medical Center will underwrite a study of the incidence of disabling chronic illness in the rural population. Based on plans developed by the Commission on Chronic Illness, the work will be in charge of Ray E. Trussell, the Medical Center director.

The **Michigan Memorial-Phoenix Project** has announced 13 new investigations. Among the recipients of grants are Joseph J. Martin (chemical and metallurgical engineering); William Beierwaltes (internal medicine); Carl D. LaRue (botany); Norman D. Kemp (zoology); Carl Lawrence (bacteriology); Harley Bartlett (botany); Paul Hough (physics); Cyrus Levinthal (biophysics); Wayne Meinke (chemistry); and Earl O'Roke (forest zoology).

At North Carolina State College, the **North Carolina Optometric Society** has provided an annual grant of $6,500 for basic and applied research in occupational vision, with special emphasis upon the relationship between visual skills, and school and job success. D. J. Moffie, of the Department of Psychology, will direct the project, with the assistance of Howard C. Olson.

Through a grant of $289,500, the **W. K. Kellogg Foundation**, of Battle Creek, has made possible a five-year project at Ohio State for the improvement of the professional preparation of school administrators. Donald P. Cottrell will supervise the work. The Kellogg Foundation has made grants in the same field to George Peabody College for Teachers, Harvard, Teachers College (Columbia), and the Universities of Chicago and Texas.

Grants from the Penrose, Johnson, and Michaux funds totaling more than $20,000 have been announced by the **American Philosophical Society**. About a third of this amount went to the support of scientific research in botany (Robert E. Woodson, Jr., Missouri Botanical Garden; Joseph Ewan, Tulane; Henry T. Skinner, Morris Arboretum), physiology (Robert Chambers, New York University), and psychology (Keith Hayes, Yerkes Laboratory of Primate Biology).

The **Louis M. Rabinowitz Foundation** has established with a grant of $60,000 a two-year research project at Columbia to explore the issue of academic freedom. The study will begin this fall under the direction of Robert M. MacIver, Lieber professor emeritus of political philosophy and sociology, and will be in two parts, one involving a historical survey of the field here and in certain European countries, and the other concentrating on current problems and specific cases.

The Medical School of the **University of South Dakota** has received a $5,000 grant from the U. S. Public Health Service to support an investigation into the application of a recently developed diagnostic technique to the detection of brucellosis. H. N. Carlisle, chairman of the Department of Microbiology, will be the chief investigator.

The first of a series of **Thomas Alva Edison Foundation Institutes for Science Teachers** will be held May 14–16 at the Edison Foundation in West Orange, N. J. Sponsored by the foundation with the cooperation of the U. S. Office of Education, the National Science Teachers Association, and the AAAS, the institutes will try to discover techniques that will aid science teachers to recognize and develop the individual potentials of each pupil.

Miscellaneous

Many small, specialized book exhibitions are being planned for the **Festival of Britain**. In addition there will be a principal collection of about a thousand books, mediaeval illuminated manuscripts, early specimens of printing, first editions, and contemporary books at the Victoria and Albert Museum. John Hadfield, who was for six years director of the National Book League, which is coordinating the exhibitions, organized the museum show.

Experimental Parasitology, a quarterly journal to be launched this summer, invites the submission of

original papers in the field. D. R. Lincicome, Stine Laboratories, Newark, Del., will be managing editor. Members of the editorial board (to whom manuscripts may also be submitted) are H. H. Anderson, T. von Brand, E. Bueding, A. C. Chadler, E. C. Faust, Q. M. Geiman, G. van Grembergen, C. G. Huff, A. Lwoff, J. Oliver-Gonzales, C. B. Philip, W. P. Rogers, J. D. Smyth, and N. R. Stoll. Offices are at Academic Press Inc., 125 E. 23rd St., New York 10.

The Medical Library Association issued late in 1950 a *Checklist of U.S.A. and Canadian Holdings of Austrian, Belgian, French and Italian Medical and Dental Periodicals 1939–1948*. The *Checklist* serves, like its German predecessor, as an interim aid in locating foreign resources until a new edition of the comprehensive *Union List* appears. Orders, accompanied by a remittance of $2.00, should be sent to Frederick Kilgour, Treasurer, M.L.A., Yale University Medical School Library, New Haven, Conn.

Abstracts of corrosion literature will be printed by the **National Association of Corrosion Engineers** on punch cards to reduce time needed to search literature for information. The $5'' \times 8''$ cards will have two rows of holes around the perimeter, most of which have been allocated to the NACE Abstract Filing System, with the necessary indices printed adjacent to the holes. The remainder are left open for supplementary indexing by subscribers to the card service who wish to add their own system. Further information on the service may be obtained by writing the National Association of Corrosion Engineers, 919 Milam Bldg., Houston 2, Texas. Continuing the service of periodically publishing abstracts of corrosion literature in book form, the National Association of Corrosion Engineers now offers a volume containing abstracts of material published during 1946 and 1947. The book contains more than 3,000 abstracts arranged topically according to the NACE Abstract Filing Index. The price is $7.00 to members of the association, $9.00 to others; the 1946–1947 *Bibliography* may be purchased in combination with the 1945 *Bibliography* at $9.00 to members and $12.00 to others.

Joseph A. Lauwerys, professor of comparative education in the University of London, and joint editor of the University's *International Yearbook of Education*, will give two courses at Teachers College, Columbia, during the summer session, July 2–August 10. Dr. Lauwerys was a group leader at the Unesco Seminar on Textbooks in Brussels last year, and is the author of a number of textbooks.

The official journal of the Chemical Students' Association of Uruguay, formerly called *Ph* (*Revista Gremial y Cientifica*) changed its name on January 1 to *pR* (*Revista Cientifica*). It appears in one volume of six numbers per year.

The Blakiston Company has opened an editorial office at 575 Madison Avenue, New York, under the management of Associate Editor Paul K. Lapolla.

Stanford Research Institute is investigating for the AEC new constructive industrial uses for by-products of the atomic energy program. *Industrial Utilization of Fission Products—A Prospectus for Management* has been prepared by the institute under contract to the AEC's Reactor Development Division and will be available in limited supply to industrial concerns not already on its mailing list. Address Project 361, Department of Business and Industrial Economics. Active in the investigation are Paul J. Lovewell, Paul Cook, and William E. Hosken.

Results of research sponsored by Britain's **Department of Scientific & Industrial Research** in Germany after the war are now available in reports issued under the title *Sponsored Research (Germany)*. The eight reports now ready are of importance mainly to designers and users of gear-wheels, though metallurgists will find some of interest. These reports are available to industrial research departments, universities, and individual research workers and can be obtained from the Sales Department, British Information Services, 30 Rockefeller Plaza, New York 20.

The National Multiple Sclerosis Society and the library of the New York Academy of Medicine have prepared an exhibit of books and journal articles that will be on display at the library, 2 E. 103rd St., until April 30. The material includes a selection of the literature most useful to the practitioner, together with charts and photographs illustrating methods of rehabilitation.

The Smithsonian Institution, now entering upon its second hundred years—it was founded in 1846—is once more faced with the problem of finding a new secretary. Alexander Wetmore, the present incumbent, will reach the retirement age in June, and it is expected that he will vacate the post.

The Smithsonian Institution [says an editorial in the Washington *Times-Herald* for March 31], because of its unique position in the hearts of Americans, must be under the management of the best man who can be found. He must be at once a scientist, administrator and showman; a man of imagination, vision, integrity, and ability.

The selection of this man should be made outside the realm of politics, and some nominations, therefore, should come from persons completely outside the governmental circle.

Names should be asked from experts in this field such as the directors of the New York, Chicago and other Washington museums, from outstanding presidents of American universities and from leaders in the various departments of science.

Time and thought should be given to both the nominations and the final selection of the man who is to guide the institution, for he may be in office a generation or more.

Somewhere in the world there is one man under whose direction the Smithsonian will continue its fine work and will grow and expand to even greater fascination.

Let's find him.

This position now carries a salary of $17,500, which it is hoped will be sufficiently attractive to interest the right man.

2 - Spring

bulletin of new Wiley books and new editions for readers of SCIENCE

New Edition of WAHLSTROM'S

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Completely revised and modernized, the second edition of "Optical Crystallography" by Ernest E. Wahlstrom of the University of Colorado, reviews in great detail the principles of optical crystallographic theory. Emphasis is on the immersion method of determining optical properties of crystals and fragments since this method is most widely used. The construction and manipulation of polarizing microscopes and accessories are thoroughly explained. April 1951 . . . 247 pages . . . $4.50.

INSECT CONTROL BY CHEMICALS

June book by Zoology professor

Written by A. W. A. Brown of the University of Western Ontario, this book contains a wealth of information for entomologists, insecticide chemists, pest control operators, comparative physiologists, zoologists and many others. The first book to trace the relation between the chemical's molecular structure and its toxicity, the book attempts to formulate an approach which can be used to develop better control methods, evaluates insecticide hazards, demonstrates and illustrates the most modern application equipment. Ready in June . . . approx. 688 pages . . . prob. $8.00.

Three experts write up-to-date book on weed control

Gilbert H. Ahlgren of Rutgers University, Glenn C. Klingman of North Carolina State College and Dale Wolf of the E. I. DuPont de Nemours Company, have answered the need for an up-to-date, comprehensive, accurate book on this subject—"Principles of Weed Control." Contains all the facts and fundamentals associated with weeds—their life, habits, history and revolutionary new control methods. Discusses weed control in all types of crops, lawns, rights of way, etc. Ready in August . . . approx. 366 pages . . . prob. $5.00.

12 workers in radioactivity survey chemical applications

This new book "Radioactivity Applied to Chemistry" gives a comprehensive picture of what can be done and what has already been accomplished in the field. Part I covers the principles and ideas involved in the application of radioactivity to chemistry, with special emphasis on the possibilities and limitations of such research. Part II gives the factual information needed to apply the principles, including tables. The book is edited by Arthur C. Wahl and Norman A. Bonner, both of Washington University. Ready in June . . . approx. 666 pages . . . prob. $7.50.

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What GENERAL ELECTRIC People Are Saying

H. A. WINNE

Vice President

ENGINEERING STUDENTS: I am much concerned by what seems to be the too general attitude of the young men on our college campuses today. . . . It seems to be a state of mind almost bordering on panic. Often it is an attitude of "what's the use; I'll soon be in the army." Again it is a feeling of rebellion, or of self-pity, because of the uncertainty of the future. Certainly the future is uncertain—and, may I add, *as always.*

My advice, speaking very bluntly, is: quit worrying and put your effort into the job immediately ahead of you, which is to get just as much education as you can. . . .

There is a great need for engineers in industry, particularly in industries which produce defense equipment, and the list of industries so producing is growing at an astounding rate. . . .

Every year our military—as well as our civilian—materiel becomes more complex technically, requiring more scientific and engineering manhours to develop, build, operate, and service it. I am not aware that any attempt has ever been made to estimate the amount of engineering required on the munitions and materiel needed, on the average, for each military man actually in the field. I would be willing to bet that the ratio of such a figure for World War II to the corresponding figure for World War I would be in the hundreds, and I should not be surprised if it were now in the thousands, and it is still going up.

A survey recently made by Dean S. C. Hollister of Cornell reveals some disturbing figures. A simple straight-line extension of the prewar demand for engineers indicates a need for at least 20,000 technical graduates annually, and this makes no allowance for the requirements of the armed forces. Yet, based on the number of engineering freshmen entering in 1950, we can expect only 12,000 to 15,000 graduates in 1954. . . .

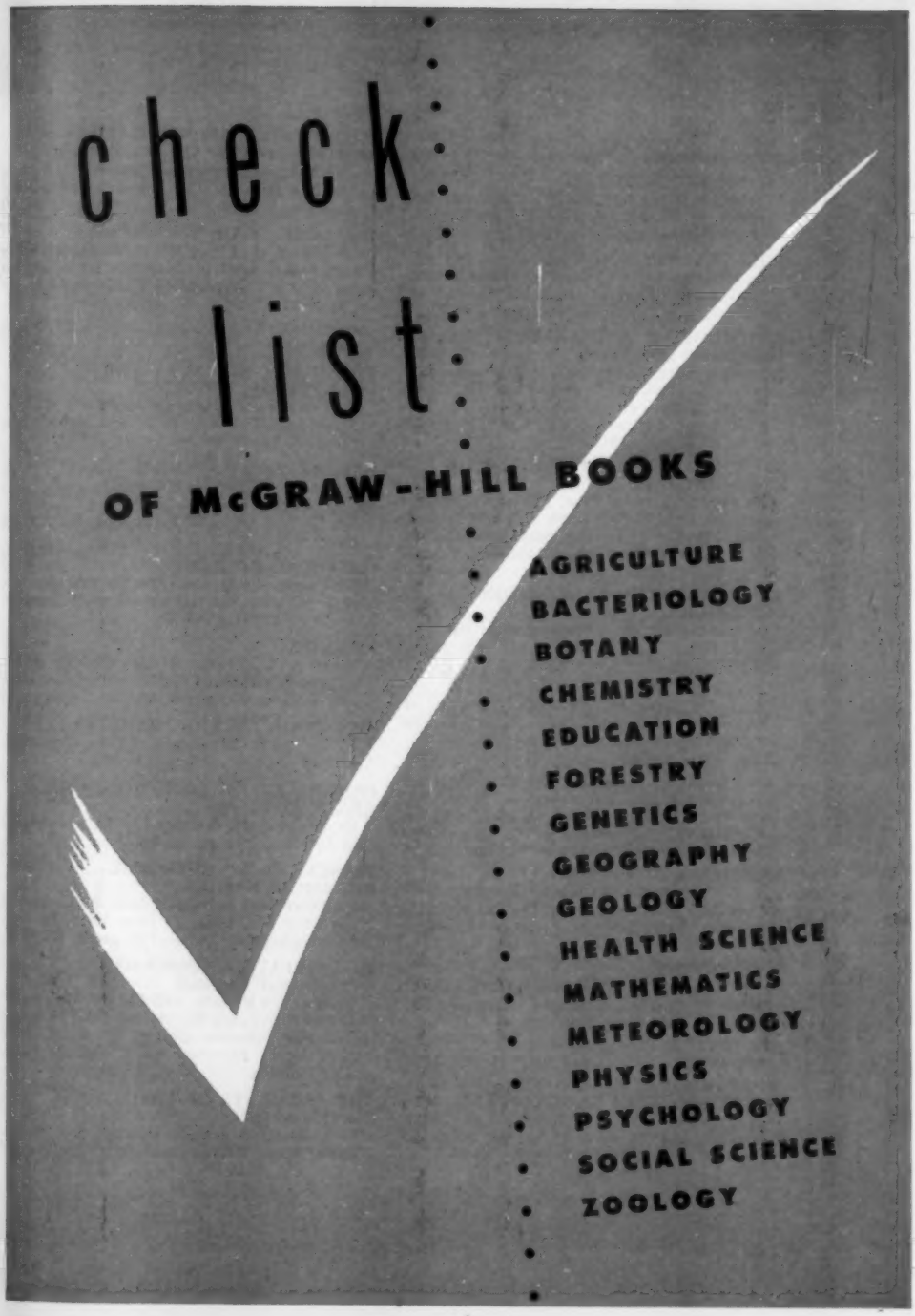
Think of our airplanes, our tanks, our guided missiles, our atomic bombs, our naval vessels, our radar. And not only are engineers needed to develop, design, and produce these devices, but the tools and factories which make them must also be engineered. And then the use and servicing of such complicated equipment calls for more engineers in our military forces. . . .

I know that . . . you do not want to be slackers. Has the thought occurred to you that, if you have the ability and the opportunity to pursue your engineering education, you may well contribute more to your country by doing that than by dropping out of college and going into military service? . . .

Bills now before the Congress on the matter of military service for our young men give recognition to the importance of maintaining a flow of men through our scientific, engineering, and medical educational institutions and into industry, as well as military forces. In World War II we paid little attention to this most important matter, whereas almost all other countries did implement such a program. Perhaps we were lucky that the war did not last longer, for then the shortage of engineers in our reconversion effort would have been much more acute.

Now we face the possibility of a long, long period of heavily armed preparedness, and we dare not stop the flow of engineers and scientists into our economy, even for a year or two.

Princeton University
March 1, 1951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It continues to stress the clinical significance of laboratory findings, making it an extremely helpful guide in diagnosis for the internist and for the medical student in any branch of clinical medicine.

By W. E. BRAY, B.A., M.D., Professor of Clinical Pathology, University of Virginia. Director of Clinical Laboratories, University of Virginia Hospital. 616 pages, 119 illustrations (18 in color). Price, $7.25

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Some of the new topics discussed are latent infection, mechanism of viral infection, the role of vertebral veins in metastasis, and the new concepts relative to the role of vitamins and endocrines to resistance.

A new chapter dealing with the Rh factor has been added and the chapter on flocculation tests used in the diagnosis of syphilis has been completely rewritten by Mr. Frank Victor, Chief Serologist of the Kansas State Board of Health. In connection with blood banks and transfusions, he has introduced a discussion of Hepatitis.

By NOBLE PIERCE SHERWOOD, Ph.D., M.D., F.A.C.P., Professor of Bacteriology, University of Kansas, and Pathologist to the Lawrence Memorial Hospital, Lawrence, Kansas. 721 pages, illustrated. Price, $8.00

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Meetings & Conferences

Apr. 20–21. American Mathematical Society (467th Meeting). Tulane University, New Orleans.

Apr. 22–26. American Ceramic Society. Palmer House, Chicago.

Apr. 22–27. Navy Industrial Health Conference. Chalfonte-Haddon Hall, Atlantic City.

Apr. 23–24. Industrial Accident Prevention Associations (Annual). Royal York Hotel, Toronto.

Apr. 23–25. National Academy of Sciences. Washington, D. C.

Apr. 23–27. Health Congress. Southport, Eng.

Apr. 24–25. American Venereal Disease Association and National Institutes of Health Symposium on Advances in Luetic Control. Federal Security Building, Washington, D. C.

Apr. 25. Adelphi College Vocational Guidance Conference. Adelphi College, Garden City, N. Y.

Apr. 26. Conference on Secondary School Problems (Annual). University of Michigan, Ann Arbor.

Apr. 26–28. American Physical Society, Division of High Polymer Physics. Washington, D. C.

Apr. 27–28. American Mathematical Society (468th Meeting). Columbia University, New York.

Apr. 27–28. American Mathematical Society (469th Meeting). University of Chicago, Chicago.

Apr. 27–28. National Speleological Society (Annual). Charleston, W. Va.

Apr. 27–28. Midwestern Psychological Association. The Drake, Chicago.

Apr. 27–28. Georgia Academy of Science, Earth Science Division. University of Georgia, Athens.

Apr. 27–28. West Virginia Academy of Science (Annual). Marshall College, Huntington.

Apr. 27–28. Western Psychological Association. San Jose State College, San Jose, Cal.

Apr. 28. American Mathematical Society (470th Meeting). Stanford University, Palo Alto, Cal.

Apr. 28. American Psychosomatic Society (Annual). Chalfonte-Haddon Hall, Atlantic City.

Apr. 28–May 20. International Textile Exhibition. Lille, France.

Apr. 29–May 3. American Association for the Advancement of Science (Southwestern Division). El Paso.

Apr. 29–May 3. Federation of American Societies for Experimental Biology (Annual). Cleveland.

Apr. 30–May 2. American Geophysical Union (Annual). National Academy of Sciences, Washington, D. C.

Apr. 30–May 11. British Industries Fair. London and Birmingham.

May 1–3. American Oil Chemists' Society. Roosevelt Hotel, New Orleans.

May 1–Sept. 30. Festival of Britain, Exhibition of Science. South Kensington, London.

May 2. National Cheese Institute, Inc. LaSalle Hotel, Chicago.

May 2–3. American Meteorological Society. Washington, D. C.

May 2–8. Mental Health Week.

May 3–4. Bone Char Conference II. National Bureau of Standards, Washington, D. C.

May 3–4. Conference on Water and Corrosion. Liége, Belgium.

May 3–5. American Association of the History of Medicine (Annual). Institute of the History of Medicine, Johns Hopkins University, Baltimore.

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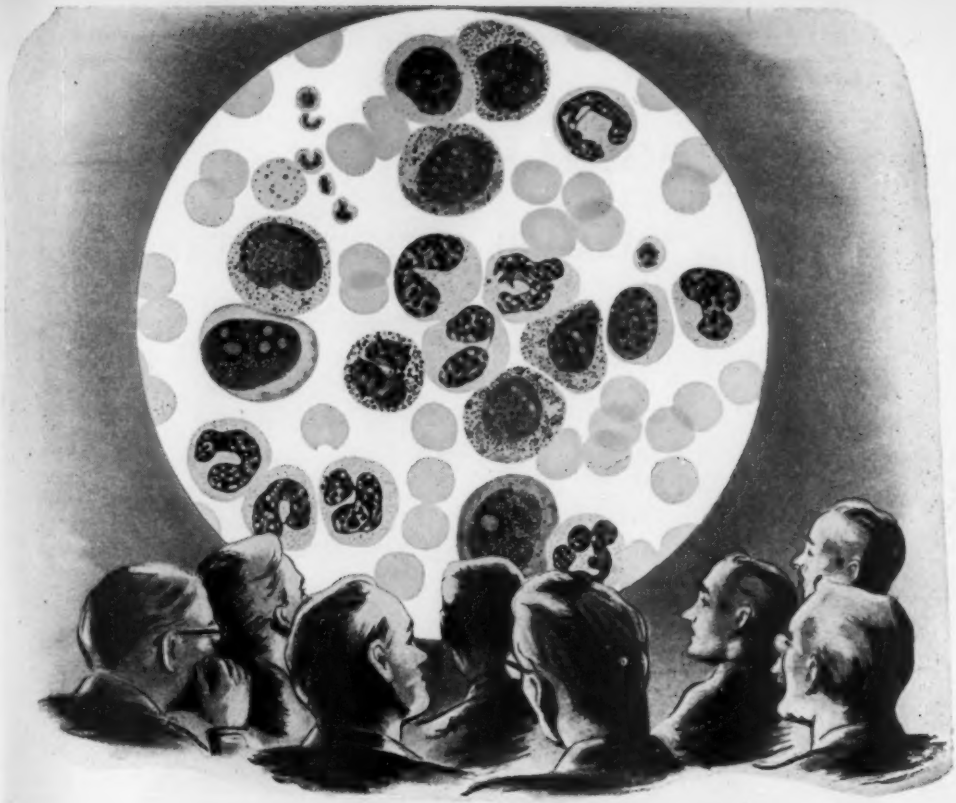

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